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XI.—ALCOHOL.

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The greatly extended use of alcohol in various industries has suggested that a review of the sources whence it is obtained might be of some value.

Ethyl Alcohol is the intoxicating constituent of all fermented beverages—cider, wine, beer, &c., and when distilled forms the base of all potable spirits, receiving different names according to the substance from which it is distilled—brandy from grapes; whisky from grain—barley, rye, &c.; gin—plain spirit, usually grain, flavoured with “Genevrier” (hence the name Geneva) or Juniper berries (*Juniperus communis*, Linn.); rum from sugar-cane, &c., which in their manufactured condition may be better described as alcoholic beverages. Whilst the substances from which alcohol may be distilled are almost unlimited, those from which it is obtained on a commercial scale are confined to products of a suitable nature, which are available in convenient and sufficiently large quantities. These consist of plants that naturally contain sugar in sufficient proportion—fruits, sugar-cane, beetroot, &c., or starch, which may be converted into sugar by fermentation—potatoes, various kinds of grain, roots, &c.

Methyl Alcohol, Wood Naptha, or Wood Spirit is obtained by the dry or destructive distillation of wood, usually, to make the business profitable, in combination with the production of charcoal, creosote, and various acids. (See § (7) Wood, &c.)

The plants or parts of plants producing alcohol here enumerated include the more important, those of local interest, a few that have been suggested as possible sources, and finally the Yeast plant which is of fundamental importance in all alcoholic fermentation, but does not need further mention here.

The sources under consideration may be conveniently divided into (1) Fruits, (2) Roots, Tuberous-roots, and Root-stocks; (3) Grain; (4) Stems; (5) Leaves; (6) Inflorescences; (7) Wood or Woody-substances; (8) Peat.

(1) FRUITS.

Grape-vine (*Vitis vinifera*, Linn., var.), cultivated in South Europe, North Africa, South Africa, Canary Islands, Syria, United States of America, South America, Australia, &c., for the production of wine, the total production of which is well over 3,000,000,000 gallons annually, the share of France, the largest producer, being well over one-third of this.¹ 12,000,000 gallons approximately are imported annually from all sources into this country.² There are many varieties, with white and black fruits. The grape is perhaps the oldest and best known source of potable alcohol—brandy, which may be distilled from any wine, but the very best is that prepared in Cognac, in the Charente Department of France, chiefly from the white grapes (var. "Folle blanche") of that locality. A product of high quality is being obtained in the Piræus, on the same principle as that employed in Cognac.³ Brandy is also produced in the United States to the extent of over 4,000,000 gallons a year. It may also be distilled from raisins—one ton will yield an average of about 145 gallons of proof spirit,⁴ from currants or currant-grape (*Vitis vinifera*, Linn., var. *corinthiaca*)—about 600 lb. of dried currants yield 100 litres of alcohol⁵—and an inferior quality is obtained from the marc of grapes and the dregs of wine vats. Grape skins to the extent of 6,757,190 gallons were used in Germany during 1908 for distillation purposes.⁶ From the stalks and pips of grapes a spirit is distilled, and forms the favourite drink of the people in Smyrna. It is used either plain or flavoured with the gum of the "Mastic" tree (*Pistacia Lentiscus*, Linn.).⁷

The colour of "pale brandy" is due entirely to the oak casks in which it is usually stored, and the rich "brown brandy" is coloured with caramel or burnt sugar. Spurious brandies are merely plain spirit, specially flavoured and coloured—usually grain-spirit sent from England or Germany to France, for preparation and return under cover of a good name. Some useful particulars of "Frauds in the Brandy Trade in France" are given in Diplomatic and Consular Report, Misc. Series, No. 72, 1887, pp. 1-3.

It has been estimated that the average percentage of total sugars calculated as dextrose in grapes is 15.0, and the approximate yield of alcohol from a ton is from 21-22 gallons.⁸

Spirit distilled from the grape is rarely if ever used for industrial purposes, although mention ought to be made here of the alcohol from currants in Greece being used for heating and lighting.⁹

¹ Blyth, "Wines and Wine making at the Paris Exhib." Journ. Roy. Hort. Soc. xxvi. Dec. 1901, p. 428.

² Annual Statement, Trade of the U. Kingdom, i. 1910, p. 233.

³ See Dip. and Cons. Rep. No. 4228, Ann. 1909, p. 8.

⁴ Perkins, Journ. Dept. Agric. S. Australia, xiii. 1909, p. 193.

⁵ Dip. and Cons. Rep. No. 3556, Ann. 1906, p. 16.

⁶ Monthly Cons. and Trade Rep. Washington, No. 339, Dec. 1908, p. 179.

⁷ I.e. No. 325, Oct. 1907, p. 95.

⁸ Wiley and Sawyer, Farmer's Bull. No. 429, 1911, pp. 11, 12.

⁹ Monthly Cons. and Trade Rep. Washington, No. 317, 1907, p. 211.

The following fruits, without reference to importance, may under certain conditions be utilised for distillation.

Apple (*Pyrus Malus*, Linn., var.), containing an average percentage of 12.2 total sugars, capable of yielding about 14 gallons of alcohol per ton.¹ 632,343 gallons of spirit were distilled from apples in the United States during 1905.²

Pear (*Pyrus communis*, Linn., var.), average percentage of total sugars, 10.0.¹ This fruit and the apple are used in France where in 1905, 2,274 hectolitres were distilled.³ It is also distilled in the Caucasus, where the production is subject to variation in proportion to the annual vintage, the loss on which in bad years is said to be made up by this and other fruit spirits.⁴

Peach (*Prunus Persica*, Benth. and Hook., var.), average percentage of total sugars, 7.6.¹

Cherry (*Prunus Cerasus*, Linn., var.), used in the distillation of "Kirschwasser" in Germany, an important centre of the industry being in the Black Forest; 100 kilos. of cherries yield about 3-4 litres of pure alcohol, or 7-8 litres of "Kirsch" at 55°. In 1908 12,684 gallons of this fruit were used for distillation purposes in Germany.⁶ The Cherry is also distilled in the Caucasus, on the same principle as given under Pear.⁴

Plum (*Prunus domestica*, Linn., var.), 64,368 gallons used in Germany during 1908.⁶

Prune (*Prunus domestica*, Linn., var. *Juliana*).

Strawberry Tree (*Arbutus Unedo*, Linn.), a small evergreen tree, native of the Mediterranean region—Southern France, Spain, &c., probably indigenous to Ireland. The berries are made into a wine in Corsica, and alcohol is obtained from them in Italy, where the spirit is sold at 40° proof,⁷ and in Zante.⁸

Banana (*Musa sapientum*, Linn.), contains 20-25 per cent. of fermentable material,⁹ a high percentage of dextrose (13.8)¹ and therefore a possible source of alcohol, but its value as a food is more than likely to outweigh any recommendation for the production of spirit except from waste material. It is reported that a very good spirit has been obtained from bananas unfit for any other purpose, in Guatemala, the yield being estimated at 4½ litres from each bunch of bananas.¹⁰ "Banana Wine" is of some importance in the Antilles, Barbados, Jamaica, Central Africa, East Africa—Kilimanjaro, Congo region, &c.¹¹

¹ Wiley and Sawyer, Farmer's Bull. No. 429, 1911, pp. 11, 12.

² Wiley, Farmers' Bull. No. 269, 1906, p. 23.

³ Monthly Cons. and Trade Rep. Washington, No. 312, 1906, p. 14.

⁴ Kew Bull. 1893, p. 224.

⁵ Spon's Encycl. i. p. 224.

⁶ Monthly Cons. and Trade Rep. Washington, No. 339, 1908, p. 179.

⁷ Simmonds, Waste Prod. and Undevel. Subs. p. 213.

⁸ Morewood, Hist. Ineb. Liq. p. 410.

⁹ Wiley, U.S. Dept. Agric. Farmers' Bull. No. 268, 1906, p. 15.

¹⁰ Journ. d'Agric. Tropicales, ix. 1909, p. 79.

¹¹ Kew Bull. 1894, p. 294.

Date-Palm (*Phoenix dactylifera*, Linn.). The fruits yield a spirit used locally in Syria, Egypt, Nubia,¹ &c. (see § (4) Stems).

Carob (*Ceratonia Siliqua*, Linn.). The pods are capable of yielding 18·25 per cent. of spirit, and according to Gennadius,² for this purpose in Cyprus finely ground Carobs are soaked in treble the quantity of hot water, and to the sugary liquid thus obtained when somewhat cooled, beer yeast and a little sulphuric acid (2 per 1000) is added. After fermentation the spirit is distilled, but distillation is only profitable when the price of the beans is not higher than 10 francs per 100 kilog. The residue is used as food for cattle and pigs.

Cashew (*Anacardium occidentale*, Linn.). A spirit may be distilled from the juicy fleshy pedicels of the fruit. The Portuguese in Goa apply this spirit externally for the cure of rheumatism, and they regard it as a valuable diuretic.³ In Mozambique, Portuguese East Africa, there is an area of about 12,000 acres, where the trees grow freely and the distillation of the spirit, subject to heavy taxation by the Portuguese Government, is an industry of some importance. (See K. B. 1898, pp. 28-29.) It does not appear that the distillation of Cashew Spirit is anywhere more than of local importance.

Prickly Pear (*Opuntia* spp.), natives of S. America. The fruits of (*Opuntia laevis*, Coult.) native of the S. U. States of America have been found to contain from 6·87 to 11·92 per cent. of sugar.⁴ For profitable distillation they should be conveniently obtainable in quantities of at least 10 tons per acre. In Malaga an average crop of fruit from 20 sq. meters is given at 2600 fruits (13 fruits to the kilog.), the average quantity of alcohol obtainable being 8 per cent.⁵ Owing to the spiny nature of the fruits both of the spiny and spineless plants, the collection is more or less of a serious difficulty, and in New Mexico, gathering the fruits by hand is said to prevent the industry being worked on a profitable basis.⁶ "Colonche" is a fermented drink made from the whole fruit in Mexico; a spirit is sometimes distilled from it. The fermented peelings of the "Tuna," for distillation is said to have proved unsatisfactory, the spirit produced had a bad effect on the natives (causing violent headaches) and they prefer Tequila and other Maguey (*Agave*) products.⁷

Central African or Desert Date (*Balanites aegyptiaca*, Delile). The fruits are used in Nupe, N. Nigeria, to make an intoxicating drink, and an alcoholic liquor is made from them on the Congo.⁸

¹ Morewood, "Hist. of Inebr. Liquors," pp. 51, 55.

² "The Carob Tree," p. 12.

³ Dymock, Pharm. Journ. [3] vii. 1877, p. 731.

⁴ U.S. Dept. Agric. Exp. St. Rec. xxiii. 1910, p. 710 (from New Mexico St. Rep. 1909, pp. 18-21).

⁵ Kew Bull. 1888, p. 172.

⁶ Journ. Roy. Hort. Soc. xxxvii. Oct., 1911, p. 237 (from "Alcohol from Tunas and other Sources," Hare, Mitchell & Bjerregaard, U.S.A. Exp. St. New Mexico, Bull. No. 72, 1909).

⁷ Hare & Griffiths, New Mexico Coll. of Agric. Exp. St. Bull. No. 64, 1907, p. 31.

⁸ Kew Bull. Add. Series ix. 1908, p. 138.

Pine-apple (*Ananas sativus*, Schult. f.), has been found to contain 11·7 per cent. of dextrose.¹ In the Federated Malay States, wines or champagnes are reported to have been made, but apparently with little success.² There seems to have been no attempt made to produce alcohol from Pines, although there must be considerable material going to waste, that might be utilised in this way, in connection with the canning industries.

Mulberry (*Morus nigra*, Linn.). A spirit is distilled from the fruits in the Caucasus, the amount produced during the five years prior to 1893, averaging 65,000 vedros (175,760 gallons). The production is subject to variation in proportion to the annual vintage, the loss on which is said, in bad years to be made up with mulberry spirits.³ A spirit is said to be sometimes distilled from the fruits of White Mulberry (*Morus alba*, Linn.) in Kashmir.⁴

Jambolana (*Eugenia Jambolana*, Lam.), a large evergreen tree, grown throughout India, Ceylon, Malaya, &c. A spirit is distilled from the fruits in Goa.⁴

(2.) ROOTS, TUBEROUS-ROOTS AND ROOTSTOCKS.

Potato (*Solanum tuberosum*, Linn. var.). The Potato is the most important source of industrial alcohol in Europe. The centre of the industry is in Germany, where the production is fostered by the State, and where it is one of the most important branches of Agriculture.

The varieties grown for distillation are white-fleshed, possessing a high percentage of starch, and good croppers.

Considerable attention has been given to the selection and improvement of suitable varieties in Germany, and those found to best meet the requirements, are "Professor Wohltman"—containing 16·3 per cent. of starch, and yielding 342 bushels of tubers per acre; "Iduna"—16·4 per cent. starch, 284 bus.; "Topaz"—17·3 per cent., 326 bus.; "Sas"—18·3 per cent., 399 bus.; "Leo"—17 per cent., 412 bus.; "Richter's Imperator"—15·4 per cent., 476 bus.; "Silesia"—16·3 per cent., 367 bus.; and "Professor Maercker," containing 14·5 per cent. starch and yielding 428 bus. per acre.⁵

The area under cultivation in Germany in 1909 was 8,212,944 acres giving a total yield of 46,706,252 metric tons of potatoes, equal to 5·68 tons per acre, 5 per cent. it is stated were diseased;⁶ in 1910 the area was estimated at 8,142,000 acres producing a crop of 42,770,000 tons or 5·25 tons per acre.⁷

The average price is about 20s. per ton, and the yield of alcohol about 25 gallons pure or 44 gallons proof from a ton of potatoes.⁸

¹ Wiley and Sawyer, U.S. Dept. Agric. Farmers' Bull. No. 429, 1911, p. 11.

² Ridley, Agric. Bull. Straits & Fed. Malay St. iii. 1904, p. 40.

³ Kew Bull. 1893, p. 224.

⁴ Watt, "Comm. Prod. India," p. 1046.

⁵ Mon. Cons. and Trade Rep. Washington, No. 312, 1906, p. 10.

⁶ Journ. Bd. of Agric. xvii. Sept. 1910, p. 502 (from Dip. and Cons. Rep. No. 4521, Ann. 1910, p. 23).

⁷ l.c. xvii. Jan. 1911, p. 865.

⁸ l.c. xii. May 1905, pp. 105-106.

Another estimate is 1 gallon pure alcohol from 1.26 bushels of potatoes.¹

The advisability of developing a similar industry in this country has been enquired into by a Committee especially appointed for the purpose, and the conclusions arrived at were, "that in the present agricultural conditions of this country it would not be possible to found a profitable industry."² In Ireland the Department of Agriculture has come to somewhat similar conclusions, unless the first cost of the potatoes was less than 29s. per ton. The success attending distillation of spirit from the potato in Germany is regarded as being due to favourable taxation, enabling the potato distilleries to compete with the cereal distilleries, the payment of a bounty on alcohol used for methylation, export, or in the manufacture of goods intended for export, the heavy cost of transport from some parts of the Empire to markets, and the consequent low net price realised for potatoes intended for consumption, and the use of a large proportion, when refined as a potable spirit.³ To these considerations may be added the use of the residue after distillation as food for cattle.

Particulars of the industry as carried on in Germany, prepared by Dr. Rose, H.M. Consul at Stuttgart are given in *The Journal of the Board of Agriculture*, vol. xi. April 1904, pp. 29-31.

Potatoes are also grown in Prussia—yield 25,630,000 metric tons in 1911;⁴ in Poland, from whence 11,000,000 gallons of spirit were exported in 1907 to Russia,⁵ where also they are grown for purposes of distillation, the cultivation becoming annually of greater importance.⁶

Beet-root (*Beta vulgaris*, Linn. var.). This is the most important source of industrial alcohol in France; the amount grown for distilleries in 1909 was 49,120 hectares, yielding 19,691,680 metric quintals; in 1910, 52,410 hectares, yielding 18,995,700 metric quintals; and in 1911, 54,535 hectares with a crop of 13,902,150 metric quintals.⁷ More than double this area is grown in the country for the production of sugar, and a certain amount of alcohol may be distilled from refuse, molasses, or from beets containing so low a percentage of sugar (4 per cent. or thereabouts) as to be unprofitable for use in the sugar factories.

The value of other roots mentioned here, lies in the starch content, but that of the beet-root turns on the sugar content, of which they may contain 13-16 per cent., capable of producing about 18 gallons of spirit per ton.⁸ Voelcker in 1870 estimated the return from an acre at 20 tons of beet-root yielding 360 gallons of proof spirit and 5 tons of pulp; the profit on a distillery working a crop of 500 acres being given at £9,000, or nearly double that of a sugar

¹ Mon. Cons. and Trade Rep. Washington, No. 312, 1906, p. 5.

² Journ. Bd. of Agric. xii. May 1905, pp. 105-106.

³ l.c. xi. March 1905, p. 733.

⁴ Bd. of Trade Journ. Dec. 7th, 1911, p. 511.

⁵ Dip. and Cons. Rep. No. 3988, Ann. 1908, p. 22.

⁶ Bd. of Trade Journ. Jan. 12th, 1911, p. 101.

⁷ Bd. of Trade Journ. Dec. 14, 1911, p. 562. The accuracy of the figures appears doubtful.

⁸ Wiley, U.S. Dept. Agric. Farmers' Bull. No. 268, 1906, p. 30, and Bull. Imp. Inst. 1907, p. 168.

factory working the same crop.¹ A more conservative estimate of the yield of roots per acre is 16 tons.²

Fifty years or so ago the cultivation of the "sugar-beet" was strongly recommended in England for the distillation of spirit. The "Silesian" variety was grown with considerable success by Mr. Robert Campbell of Buscot Park, Berkshire, for this purpose, the Savalle Stills (Paris)—famous at that period being employed in the distillation.³

Sweet Potato (*Ipomoea Batatas*, Linn.). There are upwards of 50 varieties of this plant. The variety "White Sealy," out of 16 varieties examined in Jamaica, is the best for starch content, containing 30·94 per cent., with a yield of about 7 tons of tubers per acre. In the same set "Fire brass" with pale red tubers, contained the least amount—23·74 per cent. of starch, though it yielded 11 tons of tubers per acre.⁴ Experiments in South Carolina go to show that two of the best white varieties are "Southern Queen," yielding 416 bushels per acre, containing in all 4443 lbs. of starch, producing 473·5 gallons of alcohol, and "Brazilian," yielding 450 bushels per acre and containing 4848 lbs. of starch, from which 462·2 gallons of alcohol were produced.⁵ Wiley and Sawyer estimate that sweet potatoes containing 25 per cent. of starch will yield approximately 38 gallons of alcohol per ton.⁶

Cassava (*Manihot utilissima*, Pohl.), the bitter Cassava, and (*Manihot palmata*, var. *Aipi*, Muell.-Arg.), the sweet Cassava. The roots have been found to contain 25 per cent. of starch and a ton of roots is suggested as likely to produce about 42 gallons of alcohol.⁷ The yield from dried roots has been found to be 59·8 litres per cent. on the starch content, which averages 67 per cent.⁸ This is not an established source of alcohol, but other conditions being favourable and remembering that the plant is cultivated more or less all over the tropical world for food and starch, it is not unlikely that the cultivation could be extended in order to make it valuable for the purpose under consideration. The plant is capable of yielding from 5 tons and upwards of roots per acre.

Arrowroot (*Maranta arundinacea*, Linn.). The rhizomes or root-stocks of this plant have been mentioned as a possible source of alcohol. An acre will produce approximately 5–7 tons of rhizomes capable of yielding a ton or more of dried starch.⁹ The plant is a native of Central America, Brazil, the West Indies, &c., where it is cultivated for the starch or Arrowroot. It is easily grown and comes to maturity in a few months.

Artichoke (*Helianthus tuberosus*, Linn.). The fermentable matter as laevulose and inulin in the tubers is given as from 16–18 per cent.,

¹ Voelcker, "Beetroot Distillation," pp. 86, 121.

² Inter. Sugar Journ. xiii. 1911, p. 410.

³ Voelcker, l.c. p. 40.

⁴ Cousins, Bull. Dept. Agric. Jamaica, ii. Dec. 1904, p. 277.

⁵ U.S. Dept. Agric. Exp. St. Rec. xxi. 1909, p. 432 (from S. Carolina St. Bull. No. 146, pp. 3–21).

⁶ Farmers' Bull. No. 429, 1911, p. 20.

⁷ l.c. p. 19.

⁸ Inter. Sugar Journ. xi. 1909, p. 612.

⁹ Kew Bull. 1893, p. 196.

nd with 17 per cent. of fermentable substance a ton is estimated to yield about 25 gallons of alcohol.¹ The Jerusalem Artichoke is a native of N. America; it has been commonly cultivated in this country for two or three centuries as a vegetable. It is also largely grown on the Continent for the same purpose and in Germany to some considerable extent for the production of alcohol.

Mescal Maguey (*Agave* spp.). The species of *Agave* yielding the "Mescal" or "Tequila" of Mexico are somewhat uncertain. According to Rose,² they differ principally in the thinner leaves from those *Agaves* that yield the "pulque" or fermented beverage of the Mexicans, and which have more fleshy succulent leaves. *Agave atrovirens*, Karwinski, is regarded as the usual source of pulque (q.v.).

The *Agaves* yielding "Tequila" are recognised as a possible source of industrial alcohol. The spirit is distilled from the rootstock. The distillation is of some considerable importance in Mexico, the chief seat of the industry being the State of Jalisco. The plants take from 7–12 years to mature, and the best liquor is distilled from 12-year-old plants. When harvested they are stripped of all leaves and the rootstocks are carted to the distillery. Six to twelve cart loads or 48 arrobas (1200 lb.) produce approximately one barrel (45 gallons) of Tequila.³

Yam (*Dioscorea sativa*, Linn. and *D. alata*, Linn.). Cultivated throughout Tropical Africa, West Indies, &c., for food. There are several varieties, most of which are quite capable of yielding crops equal to the Potato and Sweet Potato, and with these two crops the yam may be classified as of equal value for the production of alcohol. Wiley has estimated the percentage of fermentable matter at from 14–26.⁴

Other root-crops that have been suggested as containing fermentable material suitable for the production of alcohol are Turnip (*Brassica campestris*, Linn. var.), Carrot (*Daucus Carota*, Linn.), Parsnip (*Peucedanum sativum*, Benth. & Hook. f., var.), and Mangold (*Beta vulgaris*, Linn., var.), but as in the case of some of the fruits it is only under special circumstances that they could be profitably utilised. The distillation of Mangolds it may be mentioned was attempted in England—Cirencester, &c.—about 1860, and proved a complete failure, owing it was stated to the low percentage of sugar in the roots—rarely more than 4.5 per cent.—and to the defective distilling apparatus.⁵

Tchirish. The rootstocks of Tchirish (*Asphodelus ramosus*, Linn. and *A. albus*, Willd.), herbaceous plants, both native of S. Europe, have been found to yield a high percentage of alcohol. Samples of spirit obtained from the former were exhibited at the Paris Exhibition in 1855, and of the latter, made in Cagliari, Italy, at the

¹ Wiley and Sawyer, U.S. Dept. Agric. Farmers' Bull. No. 429, 1911, p. 18.

² "Notes on Useful Pl. Mexico" Contr. U.S. Nat. Herb. v. No. 4, 1899, p. 224.

³ Monthly Cons. and Trade Rep. Washington, No. 328, Jan. 1908, p. 119.

⁴ Farmers' Bull., No. 268, 1906, p. 27.

⁵ Voelcker, "Beet-Root Distillation," p. 40.

Exhibition of 1862. The *Asphodel* has also been used for purposes of distillation in Algeria.¹

The root bark of *Acacia Jacquemontii*, Benth., a bushy thorny shrub of India, is also said to be used in the distillation of spirit.²

(3.) GRAIN.

Barley (*Hordeum vulgare*, Linn.), the principal source of whisky distilled from the malt in this country. In Germany during 1907, 172,201 metric tons were used for distillation.³ It is also used to some extent in Russia for the purpose; the general crop for the 73 provinces in 1909, amounted to 10,148 tons.⁴ Wiley and Sawyer give the starch percentage as 58.9.⁵ Barley malt, owing to its high cost, is not advisable as a source of industrial alcohol, but it is a convenient and suitable medium for converting starch of other grain into sugar preparatory to fermentation and distillation.

Rye (*Secale cereale*, Linn.), largely cultivated in N. Europe. In Germany, 1907, there were 103,352 metric tons used for distillation.⁶ It is an important source of alcohol in Russia—"Vodka" the national drink being made from it; the crop in 1909 amounted to 22,416 tons.⁴ It is largely the "grain-spirit" redistilled to make gin. It is not much used in England, but appears to be of some importance in America where for all purposes in 1910 the total acreage was 2,155,000, yielding 32,088,000 bushels, (31,115,636 Imp. bus.)⁴ According to Wiley and Sawyer the grain contains 53.7 per cent. of starch. It is used very largely in distilleries which produce compressed yeast or rye-whisky, sometimes used in the yeast mashers of distilleries, but too expensive to be used as the chief ingredient of the mash and rarely yields over 85 gallons of alcohol per ton.⁵ Voelcker gives the yield at 16 cwt. per acre, furnishing 95 gallons of proof spirit.⁸

Maize (*Zea Mays*, Linn., var.), is the principal source of industrial alcohol in the United States of America, where the estimated acreage under corn in 1905 was 94,011,369, giving a yield of 2,707,993,540 bushels or an average of about 28.8 bushels per acre.⁹ Maize is also used in Bilbao, Spain, for distillation.¹⁰ Distillers' Corn ("Yellow Dent"), has been found to contain 57.9 per cent. of starch and 2.3 per cent. of sugars. One ton (United States) of grain made up of 1850 lbs. of maize and 150 lbs. of malt, is calculated to yield 100 gallons (or approx. 2.5 gallons per bushel) of alcohol; the grain contains 64 per cent. of starch.⁵

Sorghum, Guinea Corn or Dari (*Sorghum vulgare*, Pers.; *Andropogon Sorghum* var. *vulgaris*, Hack). In Germany, 1907, "dari" (and corn)

¹ Simmonds, "Waste Prod. and Undevel. Substances," p. 228.

² Agric. Ledger, No. 2, 1902, p. 60.

³ Mon. Cons. and Trade Rep. Washington, No. 339, 1908, p. 179.

⁴ Bd. of Trade Journ., Dec. 22nd, 1910, pp. 590, 591.

⁵ Farmers' Bull., No. 429, 1911, pp. 16, 17.

Mon. Cons. and Trade Rep., l.c., p. 179.

⁷ "Beet-Root Distillation," p. 121.

⁸ Wiley, U. S. Dept. Agric. Farmers' Bull. No. 268, 1906, p. 18.

⁹ Dip. and Cons. Rep. No. 3590, Ann. 1906, p. 18.

was distilled to the extent of 104,347 metric tons.¹ A spirit is distilled from the grain in Manchuria, under the name of "Kaoliang Whisky," samples of which were exhibited at the Japan-British Exhibition, London, 1910. Kaoliang seeds are used in the manufacture of "Samshu."²

Rice (*Oryza sativa*, Linn., var.). From this grain the "Sake" of Japan is made, and much of the "Arrack" of India is distilled. Sake is only a brew, like beer, but it is said to contain a larger percentage of alcohol. "Samshu" is distilled from rice, in Hong Kong, where the spirit forms the basis of several beverages prepared by flavouring with plums, oranges and other fruits.³

The spirit possesses a peculiar pungent and disagreeable odour, which makes it unsuitable for certain purposes, but it is less pungent when the husk is removed before fermentation.⁴ Wiley gives the percentage of fermentable matter in rice as nearly 78.⁵ No other cereal appears to contain so great a percentage as this, but its value as a food in China, the United States, India, Africa, &c., seems to be of greater importance than for the production of alcohol.

Ragi (*Eleusine coracana*, Gaertn.), a grass, native of India, where the seed is an important article of food. A fermented beverage is prepared from the grain, and a spirit is sometimes distilled from it.

(4.) STEMS.

Sugar Cane (*Saccharum officinarum*, Linn.). The sugar cane is cultivated more or less throughout the tropics for sugar. It is the source of rum, distilled chiefly from the molasses, the most notable being that prepared in Jamaica, where the production of rum is a leading industry.

Alcohol is also obtained from this plant in Cuba,⁶ Salvador, where in 1908 there were 62 distilleries⁷; Colombia⁸; Salaverry, Peru—the spirit exported only to Bolivia⁹—and in Mexico. The cane in Mexico yields 70 per cent. of juice on weight, giving from 9–10 per cent. of alcohol, and the cost per litre of producing 96 per cent. alcohol from sugar-cane juice averages a little more than 1 centimo ($\frac{1}{2}$ cent) after the cane is delivered at the mill, which can be done for from 4–6 pesos (about 2–3 dollars) per ton.¹⁰ "Aguardiente" made from cane-sugar is one of the chief distilled drinks of Mexico¹¹ and in Colima, Mexico, the annual production of spirit is given at 262,000 litres, value (1907) 23 cents per litre.¹²

¹ Mon. Cons. and Trade Rep. Washington, No. 339, 1908, p. 179.

² Dip. and Cons. Rep. Ann. No. 4424, 1910, p. 11.

³ Col. Rep. Ann. No. 659, 1910, p. 13.

⁴ Bell, in Pharm. Journ. [2] xi. 1870, p. 358.

⁵ Farmers' Bull. No. 268, 1906, p. 28.

⁶ Mon. Cons. and Trade Rep. Washington, No. 311, Aug. 1906, p. 132.

⁷ l.c. No. 334, July 1908, p. 81.

⁸ l.c. No. 341, 1909, pp. 149–150.

⁹ Dip. and Cons. Rep. No. 3635, Ann. 1906, p. 34.

¹⁰ Mon. Cons. and Trade Rep. Washington, No. 332, May 1908, pp. 85–86.

¹¹ Rose, "Useful Pl. Mexico," Contr. U.S. Nat. Herb. v. No. 4, 1899, p. 224.

¹² Dip. and Cons. Rep. No. 3888, Ann. 1907, p. 28.

A small but interesting local industry exists in San Josi di Talisco, near Sucre, Bolivia, where, in 1905, 1050 cwts. of 90 per cent. alcohol (including perhaps some from other cereals) were distilled from sugar-cane in one distillery, and the out-put from various smaller distilleries amounted to another 1000 cwt. It is claimed that the Talisco alcohol is superior to that of German and Peruvian origin, which occasionally reaches that district; the tins in which the spirit is usually sold contain 37 lbs. net, value wholesale (1906) 24s. per tin.¹

Sugar Corn (*Zea Mays*, Linn.). The stems, according to Wiley and Sawyer,² contain from 7–15 per cent. of sugar; the waste stalks amount to about 40 per cent. of the total weight of corn, and are capable of yielding from 6–10 per cent. of alcohol or about 11 gallons to every ton of corn. The season, however, during which these stalks are in a fit condition for the production of alcohol is so limited that it is open to question if it would pay, unless other materials were available to keep the distillery working during the remainder of the year. It seems only possible to use these stalks when freshly cut or at the time when the sweet corn is ready for market, as in curing them for fodder the sugars ferment and are lost.³ The production of alcohol from the stems is suggested in connection with the corn-canning industry.

Sugar Sorghum (*Sorghum saccharatum*, Moench, var.). Cultivated in N. India, China, Japan and N. America. The stalks are recommended as a likely source of alcohol. 1000 lbs. of the juice of the variety "Colman," containing 14.42 per cent. of sucrose and 1.1 per cent. of reducing sugars, is calculated to yield 12½ gallons of 180° alcohol, and the production of alcohol from a ton of cleaned stalks may be from 15 to 18 gallons.⁴

Grass Trees or Black Boys (*Xanthorrhoea Preissii*, Endl., and other species). Perennial plants with thick short or arborescent woody stems and leaves in a dense apical tuft. The genus is confined to Australia. The inner part of the stem has been suggested as a source of industrial alcohol, and proposals have been advanced to utilise the trees in Victoria⁵ (over 100,000 acres), Queensland⁶ and West Australia,⁷ where the plants cover large areas. The success of such a venture would, however, be open to question in view of the availability of other and better sources. The present value of the stems lies in the resin or "Grass tree gum" of commerce, which exudes naturally from the bases of the old leaves; used for making spirit varnishes and for staining wood.

Sotol (*Dasylirion texanum*, Schult). "Sotol" is a spirit similar to "mescal" (see *Agave* spp.) obtained from the crown of this plant. The Sotol plant has been found to yield 16 per cent. of laevulose.⁸

¹ Dip. and Cons. Rep. No. 3600, Ann. 1906, p. 24.

² Farmers' Bull. No. 429, 1911, p. 15.

³ L.c. No. 268, 1906, p. 33.

⁴ L.c. No. 429, 1911, pp. 13, 14.

⁵ Bd. of Trade Journ. Nov. 19th, 1908, p. 377.

⁶ L.c. May 20th, 1909, p. 399.

⁷ Journ. Dept. Agric. W. Australia, 1907, p. 514.

⁸ Wiley and Sawyer, U.S. Dept. Agric. Farmers' Bull. No. 429, 1911, p. 11.

The Dasyliirions are mostly natives of Mexico, where they grow in comparatively waste dry regions.

Date Palm (*Phoenix dactylifera*, Linn.) and **Wild Date** (*Phoenix sylvestris*, Roxb.). Sometimes the sap obtained from the stems is distilled into spirit in India, but the former plant is of greater importance for the fruit and the latter for the production of sugar or "Jaggery."

(5.) LEAVES.

Utshkui (*Heracleum Sphondylium*, Linn.), an Umbellifer, native of Europe and N. Asia. The petioles of the leaves have been used in the preparation of alcoholic beverages in Russia, Poland, Kamschatka, &c. In Russia a spirit is obtained by fermenting and distilling an infusion of the petioles from which the outer skin has been removed, a necessary condition, as the spirit would otherwise be poisonous. The berries of *Lonicera coerulea*, Linn., or berries of *Myrtle* (*Myrtus communis*, Linn.), are added to the mash, and the spirit when rectified is said to be more palatable than that of native corn-spirit.¹

Sisal Hemp or Henequen (*Agave rigida*, Mill. var. *sisalana*, Pers.). It has recently been found possible to produce a spirit from the waste fleshy matter of the leaf scraped off in the process of extracting the fibre and from the juice of the leaf. The discovery is due to a resident in Yucatan and some importance is attached to it as an auxiliary to the already important fibre industry.²

(6.) INFLORESCENCES.

Palmyra or Black Run Palm (*Borassus flabellifer*, Linn.), native of Tropical Africa; cultivated in India, Burma and Ceylon. From the unopened spathes of this palm a sap is drawn, known in India as "toddy," from which the spirit "arrack" is distilled. According to Watt the tapping does not injure the wood as in the case of the date-palm, since it is only necessary to bruise the flower stalk and to crush the young flower or fruit within, and with this object slices of the spathe are made for several days in succession. An earthen pot into which the sap runs is tied to the end of the stump, and if the juice is to be drunk fresh the pot is coated with lime inside in order to prevent fermentation. The Palmyra continues to yield sap at the rate of three or four quarts a day for four or five months. It begins to yield when about 15 to 20 years old and goes on for about 50 years, but once in three years the operation must be discontinued or the tree would die. The female tree yields about half as much sap again as the male. The juice is richer in sugar than most other palms; it is said that three quarts of juice will make one pound of "jaggery."³

Cocoa-nut Palm (*Cocos nucifera*, Linn.), widely distributed in tropical countries near the sea. Yields a sap from the spathe, the collection and preparation of which is done in much the same manner

¹ Pharm. Journ. [4], xxxiii. 1911, p. 779.

² Journ. Roy. Soc. Arts, lx. 1912, p. 420.

³ "Watt, Comm. Prod. India," p. 171.

as that of *Borassus*. The sap, from which spirit is distilled, is also known as "toddy" in India and "tuba" in the Philippine Islands, in both of which countries the collection of the sap for the distillation of alcohol is of some considerable importance. In the Philippines, the average daily production of "tuba" from one palm is 0·65 litre, and each tree is said to develop about ten inflorescences a year, each one yielding sap for about two months. Healthy trees give from 300-400 litres of sap annually, according to age, being considered at their best when about 40 years old.¹ In India the yield of juice is given at about 12 Madras measures (1½-2 gallons)—seven measures in the morning and five in the evening, and the length of time a tree continues to yield varies from six months to a year in very favourable soil.² The average amount of alcohol obtained from the sap is 6·1 per cent. by volume, but some loss is said to occur partly during fermentation and partly during distillation, because of the crude methods employed.³

Buri Palm (*Corypha elata*, Roxb.), common in India, Philippine Islands, &c. This palm is capable of yielding alcohol, but as it flowers only once during its life it is of no particular importance, and the yield is estimated at only about 3 per cent.⁴

Gomuti or Sugar Palm (*Arenga saccharifera*, Labill.). A tree 30-40 feet high, native of the Sunda, Molucca and Philippine Islands; cultivated in Malacca, Siam, Cochin China, Java, &c. It flowers when about 10 years old, when "toddy" may be drawn, the yield continuing for approximately two years, at the rate of about 3 quarts a day.⁵ "Arrack" is distilled from the sap in Java, the Philippines, &c. This palm also dies when the fruit is ripe or after tapping.

Nipa Palm (*Nipa fruticans*, Wurm.). A low, branched palm, stem or root-stock stout. Found in the Sunderbunds of India, extending eastwards to the Philippine Islands, and southwards to Malaya, Ceylon, Australia, &c., growing gregariously in swampy regions. This palm is the most important source of alcohol in the Philippines, the only country where it appears to be exploited on a commercial scale for the purpose. The industry gathers importance from the fact that the Nipa succeeds best in swampy land where little else is likely to grow. It is tapped for "tuba" in about the fifth year after planting, the method being on the same principle as that for the Cocoa-nut Palm (*Cocos nucifera*) and other palms mentioned; the flowering or fruiting spadix is cut near the top, a thin slice being removed each day to keep the wound open. The flow continues for about three months. The tree lives for a good number of years, upwards of 50 has been suggested⁶ as the probable period. The number of plants per hectare has been estimated at about 2,000 to 2,250, giving a yield per year of 86,862 litres of sap approximately, the average

¹ Gibbs, Philippine Journ. Science, Chem. Series, vi. June 1911, p. 154.

² Dict. Econ. Prod. India, ii. p. 450.

³ Gibbs, Lc. p. 163.

⁴ Lc. p. 178.

⁵ Dict. Econ. Prod. India, i. p. 302.

⁶ Gibbs, Philippine Journ. Science, Chem. Series, vi. April 1911, p. 116.

daily flow from each tree being 0.579 litre.¹ The yield of alcohol from the sap is given at from 4.1 to 7.5 per cent., and approximately 90,000,000 litres of sap were distilled in the Philippines (1910), producing 9,023,323 litres of proof alcohol.²

Sago Palm (*Caryota urens*, Linn.), a handsome palm, common in Tropical Asia and Malaya. A spirit is sometimes distilled from the sap, but this as an industry is of secondary importance to that of fibre ("Kittool") production.

Mahwa (*Bassia latifolia*, Roxb.). A large deciduous tree of India and Burma. In India a spirit called "Madhvi" is distilled from the flowers on an extensive scale. The approximate yield is given at six gallons per cwt. The flowers were tried in England as far back as 1877 for distillation and the refuse for feeding cattle, but although the report was favourable, no further progress seems to have been made. It has been stated that flowers exported from Bombay to France, have, after distillation, been returned to that port in the form of "French Brandy,"³ but there does not appear to be any trade in them now, and the use for distillation is probably confined to India, or to countries where the tree is abundant.

Pulque Maguey (*Agave atrovirens*, Karw., and other species). The Maguey Agaves are cultivated throughout the mountain region and on the table-lands of Mexico, for the production of "Pulque" a fermented beverage which forms the national drink of the country. Every house it is stated has a few plants growing near it to supply pulque for the family.⁴ Propagated by suckers or bulbils, the plants are ready for tapping in from 4-7 years. The flow of sap may continue for upwards of 120 days or until the plant dies, yielding under ordinary conditions from two quarts to a gallon of juice per day.⁵ The plants are tapped by cutting out the heart or central portion when the inflorescence is about to burst out and would otherwise develop into flower. This juice has been recommended as a source of industrial alcohol.

(7.) WOOD OR WOODY SUBSTANCES.

Methyl or Wood Alcohol may be obtained from almost any hard wood. The species generally used for the purpose are Beech (*Fagus sylvatica*, Linn.), Oak (*Quercus* spp.), Thorn (*Crataegus oxyacantha*, Linn.)—this in Great Britain being regarded as one of the best, though it is not always obtainable in sufficient quantities; Birch (*Betula alba*, Linn.), and Maple (*Acer saccharinum*, Wang.), &c. The value depends largely on the quantity available, convenience, cheapness, and the means of disposing of the by-products—charcoal, acetate of lime, &c. The wood may be subjected to distillation green or seasoned. It has been found that the amount of wood alcohol obtained from a cord of wood [8 ft. × 4 ft. × 4 ft. = 128 cubic ft.] in the two forms of apparatus—"oven" and

¹ Gibbs, l.c. p. 121.

² l.c. p. 128.

³ Jackson, "Comm. Botany, 19th Century," p. 150.

⁴ Rose, "Notes on Useful Pl. Mexico," Contr. U.S. Nat. Herb. v. No. 4, 1899, p. 224.

⁵ Mon. Cons. and Trade Rep. Washington, No. 328, 1908, p. 118.

"retort"—is 8 to 10 gallons, together with 45 to 52 bushels of charcoal, and 180 to 225 lbs. of grey acetate of lime; and from "kilns" 4 to 6 gallons of spirit, the same amount of charcoal and 90 to 150 lbs. of acetate of lime.¹

A cord of yellow-pine wood has been found to yield only about 3 gallons of wood-alcohol and 70 lbs. brown acetate of lime.² The Pine woods are of greater value in the production of turpentine.

Hard wood distillation is an established industry in the United States, where in 1906 it is computed 7,871,494 gallons of crude alcohol were obtained from 1,144,896 cords of wood³; in Germany and in Sweden it is being obtained from the waste wood, or residual sulphite lyes in the preparation of cellulose; on a growing scale in Canada and Australia, and on a comparatively smaller scale in this country. There is in the Forestry Museum at Kew a collection of the products of distillation of wood, presented by Messrs. Turnbull & Co., Glasgow, one of the few firms in the country engaged in the business on a commercial scale. These are: 1. Wood or Methyl Alcohol; 2. Crude Pyroligneous Acid, Wood Oil, Wood Tar, Acetone, Acetate of Lime, Acetate of Soda, Acetate of Lead (White Sugar of Lead), Acetate of Copper (Verdigris), Acetic Acid, Pyrolignite of Lead (Brown Sugar of Lead): Pyrolignite of Alumina (Red Liquor), Pyrolignite of Iron (Iron Liquor), Charcoal, Ground Charcoal for Gunpowder, Distillers' Charcoal, Ground Charcoal for Foundry purposes, Charcoal for Lawns, Golf Greens, &c. Wood naphtha is also produced at the chemical works of Mr. John Glen, Kilkerran, Maybole. The subject has received some consideration in connection with the Beechwood industry of the Chilterns. The low price, however, offered for the waste material and the uncertainty of a large and continuous supply has prevented the foundation of distilleries for the purpose.⁵ The Government has recently (1910) sanctioned the erection of a plant for wood distillation in the Forest of Dean,⁶ where the large area, approximately 24,000 acres, of timber at the disposal of the Crown, will doubtless contribute largely to the success of the undertaking, as in view of the high initial cost, it is only under such conditions, that this industry could succeed, whereas the production of ethyl alcohol can, if occasion demands, be more or less secondary to general agricultural work.

Wattle Wood (*Acacia mollissima*, Willd.) has been recommended as a source of methyl alcohol, in Natal, in conjunction with the Wattle bark industry. The limited market for the wood after the bark has been stripped for tanning, has suggested distillation to dispose of it, and some investigations have been made by Lt.-Col. Leuchars⁷ with this end in view. Dr. Wirtz (London) states that the wood compares very favourably with other woods generally used in destructive distillation and that it comes quite up to the

¹ Geer, U.S. Dept. Agric. Forest Service, Circ. No. 114, 1907, pp. 3, 4.

² I.c. p. 5.

³ Circ. No. 121, 1907. U.S. Dept. Agric. Forest Service, pp. 3, 5.

⁴ Knowledge, Feb. 1912, p. 74.

⁵ Kew Bull. 1911, p. 112.

⁶ Trans. Roy. Scottish Arboricultural Soc. xxvi. Jan. 1912, p. 99.

⁷ Natal Agric. Journ. x. 1907, pp. 1535-1539.

standard of birch and oak. A distillation test by Messrs. Davis Bros. (Manchester), showed the production as:—

	Value (in England).
Charcoal, 33·2 per cent. ; 6·64 cwt. per ton	
of wood	£3 0 0 per ton
82 per cent. Acetate of Lime 9·05 per cent. ;	
2·03 lbs. per ton of wood	12 0 0 „
Methyl Alcohol, 0·81 per cent. ; 2·15 gals.	
per ton of wood	0 2 6 per gal.

The tree is a native of Victoria, New South Wales and Tasmania. Introduced to Natal. It grows freely in comparatively poor soil and comes to maturity for the production of bark in from 5–10 years.

Sawdust. A method of treating sawdust with gaseous sulphurous acid to develop the sugar, afterwards fermenting and distilling in the usual way, has recently been devised by Prof. Alex. Classen, Technical High School, Aix-la-Chapelle.¹ This invention has been employed at St. Marcel in the Dept. of Ardeche, France, where one metric ton (2204 pounds) of sawdust yields 100 litres or 27·47 gallons of alcohol, and 20 kilos (42 lb.) of acetic acid. The residue or spent sawdust is pressed into briquettes and used as fuel. It is further stated that the wood alcohol produced by this process can be drunk or used for any other purpose to which pure alcohol is usually put.² A factory for the dry distillation of alcohol from sawdust was established at Fredrikstad, Norway, in 1897, the plant erected being capable of dealing with 10,000 tons a year.³

(8.) PEAT.

Some experiments conducted in Sweden appear likely to prove successful in producing alcohol on a commercial scale from peat. A company has been formed for the purpose of developing the industry, and it is claimed that the price of alcohol made from peat will be less than one-half of the present price of alcohol, and lower than the lowest price of refined petroleum.⁴

On the other hand it is reported that several unsuccessful trials have been made in France (Amiens) to produce alcohol from peat.⁵

In both of these countries the peat-lands are very extensive. Methyl Alcohol is largely used to denature ethyl alcohol, though other substances such as benzol, shellac, camphor, castor oil, turpentine, &c., are sometimes used. The denaturing process varies according to the prescribed regulations and the use to which the mixture is to be put. In France a standard denaturant is 15 litres of wood alcohol, $\frac{1}{2}$ litre of benzine, and 1 gram of malachite green to 100 litres of potable alcohol⁶; in Germany $2\frac{1}{2}$ litres of a "standard denaturizer" made of 4 parts of wood alcohol, 1 part pyridin, with the addition of oil of lavender or rosemary in the proportion of 50 grams to each litre, for every 100 litres of potable

¹ Mon. Cons. & Tr. Rep. Washington, No. 300, 1905, pp. 221, 222.

² l.c. No. 352, 1910, p. 140.

³ Dip. & Cons. Rep. No. 2013, Ann., 1899, p. 38.

⁴ Mon. Cons. & Tr. Rep. Washington, No. 317, 1907, p. 213.

⁵ Dip. & Cons. Rep. No. 3567, Ann., 1906, p. 34.

⁶ Mon. Cons. & Trade Rep. Washington, No. 312, 1906, p. 11.

spirit¹; an alternative method is $1\frac{1}{4}$ litres of the "standard denaturant" and 2 litres of benzol to 100 litres of ethyl alcohol, used for heating, lighting and various manufactures. Various methods are allowed for denaturing, sufficient to prevent drinking, but suitable for various uses in which complete denaturing as above would not be practicable. The process in the United States is 10 gallons wood alcohol, $\frac{1}{2}$ gallon of benzine, to 100 gallons of ethyl alcohol²; in England 10 per cent. methyl alcohol, and 3 per cent. benzine,³ and in the Transvaal the formula is 97.5 rectified spirit, 2.0 wood spirit and 0.5 pyridine.⁴

Other instances might be quoted, but the above go to show that the methods of denaturing are almost universally the same. Alcohol is in most countries an important source of revenue, and the production, denaturisation, disposal and use are all more or less regulated by law.

The chief uses to which the denatured product or "industrial alcohol" is put are heating, lighting, and motive power—converted into gas or as fuel. It is not unusual even now in agricultural operations for alcohol to be spent in working machinery over the same ground which grew the material from which it was developed, and its value will increase in proportion to the improvements made in apparatus and machinery adapted to the uses for the above purposes. Amongst the many manufactures in which alcohol is indispensable may be mentioned varnishes, celluloid, synthetic camphor, gelatine, lanolin, soap, hats, artificial silk, various chemical and pharmaceutical preparations, photographic paper, plates, &c., ink, coal-tar colours, vinegar, smokeless powder, &c.

This paper claims little more than merely to indicate the plants from which alcohol is obtained, and though it probably does not exhaust all the possible sources, it covers the best known.

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¹ I.c. No. 299, Aug. 1905, p. 245.

² Mon. Cons. & Trade Rep. Washington, No. 315, 1906, p. 192.

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XII.—NEW ORCHIDS: DECADE 38.

371. *Pleurothallis repens*, *Rolfe*; affinis *P. Josephensi*, *Rodr.*, sed sepalis lateralibus fere ad apicem connatis et colore florum differt.

Rhizoma repens, gracile, internodiis circiter 1–1.4 cm. longis. *Caules* secundarii graciles, circa 2.5–3 cm. longi. *Folia* elliptico-oblonga, carnosa, apice tridenticulata, 3.5–4.5 cm. longa, 1.2–1.4 cm. lata. *Pedunculi* uniflori, graciles, circiter 1.2 cm. longi. *Bracteae* ovatae, minutae. *Flores* subcarnosi. *Sepalum* posticum oblongum, subacutum, 1.4 cm. longum, 4 mm. latum; sepala lateralibus fere ad apicem connata, limbus elliptico-oblongus, profunde concavus, apice bicuspidatus, 1.2 cm. longus. *Petala* lineari-lanceolata, subobtusata, 4 mm. longa. *Labellum* oblongum, obtusum, concavum, scabridum, basi subauriculatum, 4 mm. longum. *Columna* clavata, 3 mm. longa.

S. BRAZIL.

Found in a clump of *Laelia purpurata*, *Lindl.*, and flowered in the collection of Sir Frederick Wigan, Bart., Clare Lawn, East Sheen, in January, 1904. The sepals and petals are pallid, striped with purple-red, and the rest of the flower reddish brown.

372. *Dendrobium* (*Ceratobium*) *Imthurnii*, *Rolfe*; a *D. antennato*, *Lindl.*, caule multo altiore et crassiore, foliis multo latioribus, labello longiore et petalis brevioribus differt.

Caules aggregati, 1–1.25 m. alti, basi 2.5–3 cm. lati, supra attenuati, pluriarticulati, foliosi. *Folia* elliptico-oblonga, obtusa, valde coriacea, 7–10 cm. longa, 3.5–5 cm. lata. *Racemi* axillares, prope apicem ramorum producti, circiter 35 cm. longi, suberecti, multiflori. *Bracteae* late triangulari-ovatae, acutae, 2–4 mm. longae. *Pedicelli* 4–5 cm. longi. *Flores* mediocres, albi, labelli lobis lateralibus lilacino-lineatis. *Sepalum* oblongo-lanceolatum, acutum, spiraliter semitortum, 2 cm. longum; sepala lateralibus similia, basi obliqua, et in mentum triangulare acutum 1 cm. longum extensum. *Petala* subpatentia, linearia, acuta, basi attenuata, supra paululo dilatata et torta, 3–3.5 cm. longa. *Labellum* trilobum, 2.5 cm. longum; lobi laterales oblongi, obtusi, minute crenulati; lobus intermedius obovato-lanceolatus, acutus, minute crenulatus, 1.3 cm. longus, circiter 6 mm. latus; lamellae per discum parallelae 3, prope apicem dilatatae, truncatae et minute crenulatae. *Columna* oblonga, 6 mm. longa.

SOLOMON ISLANDS. *Sir Everard im Thurn.*

A very robust species, allied to *D. antennatum*, *Lindl.*, to which its flowers bear a considerable resemblance, but far more robust in every respect. It was brought from the Solomon Islands by Sir Everard im Thurn, K.C.M.G., late Governor of Fiji and High Commissioner of the Western Pacific, and flowered at Kew in August, 1911.

373. *Bulbophyllum* (*Oxysepalae*) *congestum*, *Rolfe*; a *B. odoratissimo*, *Lindl.*, floribus minoribus et sepalis multo brevioribus differt.

Rhizoma repens, subgracile; internodia 3–5 cm. longa. *Pseudobulbi* oblongi, obscure tetragoni, 2–3 cm. longi, monophylli, basi vaginis ovatis membranaceis obtekti. *Folia* sessilia, oblonga, obtusa, coriacea, 4–7 cm. longa, circiter 1.5 cm. lata. *Scapi* axillares, erecti, 3–6 cm. longi, vaginis ovatis acutis obtekti; inflorescentiae capitatae, 1.2–1.5 cm. latae, multiflorae. *Bracteae* lanceolatae,

acuminatae, 5-7 mm. longae. *Pedicelli* 4-5 mm. longi. *Flores* parvi, albiduli, labello pallide flavo. *Sepala* subpatentia; posticum ovato-oblongum, apice angustum et subobtusum, basi subconcaevum, 3-3.5 mm. longum; lateralialia ovata, apice angusta vel subcaudata et subobtusum, 4-5 mm. longa. *Petala* ovata, subobtusum, circiter 1 mm. longa. *Labellum* recurvum, ovato-oblongum, obtusum, obtuse bicarinatum, circiter 1 mm. longum. *Columna* lata, apice obtuse bidentata.

BURMA and S.W. CHINA. Kachin Hills, *Mohum*, and mountain forests to south of Szemao, in the Province of Yunnan, 1220 m. *A. Henry*, 12,291.

Flowered in the Royal Botanic Gardens, Glasnevin, in September, 1910. It is markedly different from *B. odoratissimum*, Lindl., in its smaller flowers, much shorter sepals, and pale yellow, not brown lip, though in habit the two are much alike.

374. *Cirrhopetalum Micholitzii*, *Rolfe*; a *C. retusiusculum*, Hook. f., floribus minoribus, sepalis lateralibus acutis et aureis differt.

Rhizoma repens, lignosum; internodia brevissima. *Pseudobulbi* ovoidei vel ovoideo-oblongi, 1.5-2.5 cm. longi, vaginis membranaceis venosis obtekti, monophylli. *Folia* oblonga vel lanceolato-oblonga, obtusa, coriacea, basi attenuata, 7-8 cm. longa, 1.5-1.8 cm. lata. *Scapi* graciles, suberecti, circiter 15 cm. longi, vaginis paucis obtekti. *Umbella* 8-12-flora. *Bracteae* lineari-lanceolatae, acuminatae, 5-6 mm. longae. *Pedicelli* 8-9 mm. longi, graciles. *Sepalum* posticum oblongum, truncatum, minutissime denticulatum, 3-nerviis, 3 mm. longum, purpureo-striatum et marginatum vel purpureo-punctatum; sepala lateralialia connata, lineari-oblonga, acuta, 2 cm. longa, aurea. *Petala* sepalis postico similia et concoloria. *Labellum* recurvum, lineari-oblongum, obtusum, carnosum, 2 mm. longum. *Columna* lata, 1 mm. longa; stelidia subulata, acuta, brevissima.

ANNAM. Lang Bian, 1500 m., *Micholitz*.

Flowered at the Royal Botanic Gardens, Glasnevin, and with Messrs. Stuart Low & Co., in October, 1910. The lateral sepals are deep yellow, and the dorsal sepal and petals blotched with dark purple on a pale ground, or in one case the spots were confluent into lines, but identical in other respects.

375. *Polystachya repens*, *Rolfe*; species distinctissima, minuta, a speciebus adhuc notis rhizomate repente et caulibus brevissimis facile distinguenda.

Rhizoma repens, radices numerosos graciles pubescentes emittens. *Caules* brevissimi, circiter 2 cm. longi, vaginis brevissimis obtekti, apice diphylli. *Folia* sessilia, suborbicularia, apice minute emarginata, coriacea, 4-5 mm. longa. *Scapi* terminales, 4-5 mm. longi, prope apicem vaginis latis brevibus obtekti, uniflori. *Bracteae* late ellipticae, obtusae, 1-5 mm. longae. *Sepalum* posticum oblongo-lineare, subacutum, recurvum, circiter 7 mm. longum; sepala lateralialia similia, paulo breviora, basi in mentum breve subsaccatum extensa. *Petala* oblongo-linearia, acuta, recurva, 6 mm. longa. *Labellum* integrum, ovato-lanceolatum, acutum, recurvum, 2 mm. longum. *Columna* brevissima; pollinia 4, elliptico-oblonga, visco parco cohaerentia.

TROPICAL AFRICA. Uganda, *Brown*.

A minute and very distinct species which flowered in the collection of Sir Trevor Lawrence, Bart., Burford, Dorking, in November, 1911. The creeping habit is remarkable, and apparently marks it as a much reduced member of the group containing *P. superposita*, Reichb. f. The sepals and petals are buff yellow striped with brown, and the lip deep red-brown.

376. *Chondrorhyncha Lipscombiae*, *Rolfe*; affinis *C. albicanti*, Rolfe, sed foliis longioribus, floribus majoribus et labello subtrilobo differt.

Herba caespitosa. *Folia* arcuata vel suberecta, elongato-lanceolata, acuta, basi conduplicata, supra basin articulata, 8–30 cm. longa, 2–2.5 cm. lata. *Scapi* patentes, graciles, circiter 6–7 cm. longi, vaginis paucis obtecti. *Bractee* oblongae, obtusae, 1 cm. longae. *Sepala* subpatentia, oblongo-lanceolata, acuta, subconcava, sepalum posticum 2 cm. longum, lateralia 2.5 cm. longa. *Petala* oblongo-lanceolata, acuta, 2 cm. longa. *Labellum* concavum, fere quadratum, subtrilobum, 2.3 cm. longum et latum, basi subsaccatum, apice obcordato-bilobum; lobi laterales ovato-rhomboides, subacuti; crista transversa, membranacea, apice 5–7 dentata. *Columna* late clavata, 1.6 cm. longa.

PANAMA.

Flowered in the collection of Mrs. Lipscomb, Wilton Grove, Wimbledon, in December, 1911. It was found by her son, Mr. Lancelot Lipscomb, when helping to clear some "bush" for rubber and cocoa planting, and was sent home with a good many others in 1910. The flowers are white, with some light purple veins on the lip.

377. *Gongora Tracyana*, *Rolfe*; a *G. Scaphephoro*, Reichb. f. et Warscew., floribus duplo minoribus et labelli lobis lateralibus aristatis differt.

Pseudobulbi ovoidei, angulati, 3–5 cm. longi, vaginis ampliatis ovatis vestiti, apice diphylli. *Folia* elliptico-lanceolata, subacuta, trinervia, subcoriacea, lucida, basi attenuata, 20–25 cm. longa, 5–6 cm. lata. *Scapi* penduli, graciles, glabri, 35–45 cm. longi; racemi 35 cm. longi, laxi, multiflori. *Bractee* oblongo-lanceolatae, acutae, 8 mm. longae. *Pedicelli* subgraciles, 2.5–3.5 cm. longi, horizontales, apice decurvi. *Sepalum* posticum lanceolatum, acutum, concavum, 1.3 cm. longum, marginibus revolutis; sepala lateralia reflexa, oblongo-lanceolata, acuta, 1.4 cm. longa, marginibus valde reflexis. *Petala* triangulari-oblongi, falcati, acuti, 2 mm. longi. *Labellum* incurvum, trilobum, 9 mm. longum, basi valde concavum; lobi laterales basi lati, apice falcato-setiferi, setis incurvis 4 mm. longis; lobus intermedius ovatus, conduplicatus, subobtusus, 4 mm. longus; callus obovato-oblongus, truncatus, compressus, 2 mm. longus. *Columna* clavata, 1 cm. longa.

PERU. *Kromer*.

Introduced by Mr. H. A. Tracy, Amyand Park Road, Twickenham, and flowered in the collection of Mr. J. S. Bergheim, Belsize Park, N.W., in March, 1911, and shortly afterwards with the importer. The sepals and petals are greenish-yellow barred and blotched with brown, and the lip ivory white, with a few brown lines on the basal half.

378. *Angraecum Andersonii*, Rolfe; ab *A. caespitoso*, Rolfe; radicibus crassioribus, labelli limbo late elliptico et obtuso, et calcare supra medium crassiusculo differt.

Caulis brevis, aphyllus, radicibus numerosis flexuosis crassiusculis ad 60 cm. longis interdum ramosis instructus. *Scapi* valde numerosi, erecti, graciles, 3-4 cm. longi, basi vaginis brevissimis instructi, 6-10-flori. *Bractee* brevissimae, obtusae vel minute apiculatae. *Pedicelli* graciles, 1-1.5 cm. longi. *Flores* breves subglobosi. *Sepalum* posticum late elliptico-oblongum, obtusum, concavum, 3.5 mm. longum; sepala lateralalia oblique ovata, obtusa, concava, 4 cm. longa. *Petala* late elliptico-oblonga, obtusa, subconcava, 3.5 cm. longa. *Labellum* integrum, late ellipticum, obtusum, concavum, 2.5 cm. longum. *Calcar* 1 cm. longum, anguste fusiformi-oblongum, obtusum, prope apicem subconstrictum, 1 cm. longum. *Columna* oblonga, 1.5 cm. longa; anthera obcordata, rostrata, rostro ascendente; pollinia subglobosa; stipes linearis; glandula lineari-oblonga, stipite sublongior.

TROPICAL AFRICA. Gold Coast, *Anderson*.

A curious leafless species which flowered at the Royal Botanic Garden, Glasnevin, in December, 1911, whence it was sent for determination by Sir F. W. Moore. The flowers are semi-pellucid white, with a broad emerald-green line on the sepals, a green centre to the lip, and a green column.

379. *Physurus validus*, Rolfe; *P. roseo*, Lindl., omnino affinis, sed scapo et inflorescentia parce pilosis, bracteis et floribus non roseis differt.

Folia elliptico-lanceolata, acuta, submembranacea, basi attenuata, circiter 13 cm. longa, 3-5 cm. lata. *Scapus* validus; spica elongata, densa, multiflora, circiter 15 cm. longa; rachis parce pilosa. *Bractee* lineari-lanceolatae, acuminatae, 1-2 cm. longae, glabrae, pallide virides. *Pedicelli* arcuati, parce pilosi, circiter 1 cm. longi. *Flores* parvi, albiduli. *Sepalum* posticum late oblongum, obtusum, 3-4 mm. longum; sepala lateralalia linearia, subobtusa, 4-5 mm. longa. *Petala* oblique oblonga, subobtusa, 3-4 cm. longa. *Labellum* 4 mm. longum, basi angustum, apice in limbum lunatum expansum, 4 mm. latum; calcar cylindricum, obtusum, incurvum, 5 mm. longum. *Columna* 3 mm. longa.

PERU.

Flowered in the Royal Botanic Garden, Edinburgh, in January, 1911. It resembles the Brazilian *P. roseus*, Lindl., very closely in habit and floral structure, but from the differently coloured bracts and flowers and the different habitat is probably distinct. There is only a sketch of *P. roseus* in Lindley's Herbarium, the species being described from a specimen in Martius' Herbarium. It is also allied to the Peruvian *P. bifalcis*, Lindl., but has a much stouter denser inflorescence.

380. *Habenaria* (*Ceratopetala*) *Dawei*, Rolfe; species insignis, a *H. cirrhata*, Lindl., foliis radicalibus amplioribus et sepalis multo latioribus distincta.

Folia radicalia, elliptico-oblonga, subobtusa, membranacea, 15-20 cm. longa, 6-8 cm. lata. *Scapus* validus; racemus circiter 25 cm. longus, circiter 10-florus. *Bractee* sessiles, lanceolatae, acutae, vel acuminatae, 4-6 cm. longae. *Pedicelli* 7-8 cm. longi. *Sepalum*

posticum ovato-oblongum, subobtusum vel apiculatum, 2 cm. longum, sepala lateralia patentia, obliqua, semiovata, subobtusum vel apiculata, 2 cm. longa. *Petala* profunde bipartita; lobus posticus linearis, falcatus, 2 cm. longus; lobus anticus linearis, arcuatus vel incurvus, circiter 6 cm. longus, crassiusculus. *Labellum* profunde tripartitum; lobi filiformes, apice incurvi; lobi laterales 2.5 cm. longi; lobus intermedius 3 cm. longus; calcar 12-14 cm. longum, basi filiforme, apice crassiusculum. *Anthera* oblonga, 8 mm. longa. *Stigmata* 2 cm. longa, apice subito dilatata et subcompressa; rostellum lobi laterales lineares, 2 cm. longi.

TROPICAL AFRICA. Uganda: Budongo Forest; in open grass land, *Dawe*, 1926.

A fine species, of which the radical leaves and the upper part of the scape only were sent.

XIII.—THE ARUNDINARIAS OF THE HILLS OF SIKKIM.

J. S. GAMBLE.

In the 'Flora of British India,' vol. vii, the following species of the genus *Arundinaria* are mentioned as being found in the hills of Sikkim and British Bhutan, included politically in the British District of Darjeeling and the native State of Sikkim.

No. 5. *A. polystachya*, Kurz, a soft-stemmed rather large-leaved species, collected by Kurz and T. Anderson and apparently scarce.

No. 8. *A. racemosa*, Munro, the most common species, rarely found in flower, except at high elevations and then more or less stunted.

No. 9. *A. Griffithiana*, Munro, a species with thorny nodes, which has apparently only once been collected, viz.: by R. Pantling at Paonggong, 10,000 ft. (1895) on the Bhutan border.

No. 10. *A. Pantlingi*, Gamble, a similar species which may perhaps also be thorny at the nodes, also collected by R. Pantling at Rechi La, 11,000 ft. on the Bhutan border, and by Mr. G. A. Gammie's collector near Jongri in Sikkim.

No. 14. *A. intermedia*, Munro, a small species with long-ciliate leaf sheath and no cross-bars to the leaves, found at comparatively low levels in the outer hills.

No. 15. *A. Hookeriana*, Munro, a handsome rather large species with glaucous green or bluish culms also found in the outer hills at comparatively low levels.

No. 17. *A. aristata*, Gamble, a pretty species of the section *Thamnochloa*, found growing gregariously in the higher hills and easily recognised in flower by the aristate glumes, and generally by its yellow stems and reddish branchlets.

No. 18. *A. Falconeri*, Gamble, a rather scarce species, found in the forests around Senchul and in various parts of Sikkim, above 7000 ft. It is recognisable by the absence of regular transverse veinlets to the leaves and by the sheathing bracts of the inflorescence.

No. 26. *A. suberecta*, Munro, a species which has not yet been found in flower. It has very narrow leaves and was only once collected in Sikkim, viz., by W. A. Kennedy in 1891.

Among these nine species there is one about which there has been a considerable amount of doubt. It is that described by General Munro as *A. racemosa*; and it undoubtedly consists, as first suggested in the "Bambuseae of British India" and afterwards emphasised by Sir D. Brandis in his 'Indian Trees,' of two forms, a high-level one 2 to 4 ft. in height and a low-level one reaching 12 to 15 ft. and even 30 ft. This low-level form is the plant so common in the woods around the hill station of Darjeeling, used for mat-making, roofing material, fencing and fodder, and known to the Nepalese collectors of fodder for horses as 'Maling.' Naturally, in such places, it is so much cut for fodder that it remains small, but at a little distance away, as on the slopes of Mounts Tonglo and Sandukpho or the Nepal frontier, it grows in dense thickets gregariously and is often found with oaks and rhododendrons, and in places with large yew-trees and trees of *Tsuga Brunoniana*. During a residence, off and on, of about 10 years, as a Forest Officer in Darjeeling, I searched for the flowers constantly and never found them, and others have done the same, as, for instance, Mr. G. A. Gammie who, in a letter quoted at p. 10 of the "Bambuseae of British India," wrote "a plant which, although so abundant round Darjeeling as to be almost exclusively used as fodder for ponies, has never been known to flower there." On the other hand, in a note by Mr. G. H. Cave communicated to me by Mr. W. W. Smith, late Curator of the Herbarium of the Calcutta Botanic Gardens, he says, "my own opinion is that individual specimens of the small bamboo, *A. racemosa*, common from 6000 to 10,000 ft. and not found below 5500 ft., flower at least every third year (possibly it could be found every year), and that the flowering plant though crippled does not necessarily die. The Lepcha collectors and the 'grass cutters' and others confirm this, although most of them say that the flowering plant dies." It seems strange that, if it is the case that it is so often in flower, specimens of the flowers are not to be found in the Herbarium at Kew, nor, I think, in that at Calcutta. The first flowering specimens that I have seen are those which were collected in May, 1904, by Mr. B. B. Osmaston, then Deputy Conservator of the Darjeeling Forests, on the slopes of Mount Tonglo at 9000 ft. He calls it 'sporadic-flowering,' and his specimens are very good and are accompanied by leaves and leaf-sheaths which clearly are those of the low-level form. These collections are probably those referred to by Brandis as mentioned in a Bengal Forest Report. Press of other work prevented my examining these specimens carefully till quite recently, but I have now done so and find that the flowers have characters which differ from those of the high-level form which were those from which Gen. Munro prepared his description. Of the specimens mentioned by Munro at p. 17 of his 'Monograph of the Bambusaceae' only one belongs to the low-level form. It is that collected at Mainom by Sir J. D. Hooker (collection Hook. f. & Th.) at 8000 ft. on Dec. 27, 1848, Vern. '*Pummoon*,' and is in leaf only. The specimen is in the Kew Herbarium, labelled '*Arundinaria spathulacea*' and '*A. spathiflora*'; the culms are said to have been 12 ft. high. They have scabrous internodes, glabrous leaves with 4-5 pair of main nerves and are 12-14 cm. long and 1-5 cm. broad; the leaf sheaths with few ciliae at the mouth. Mainom is a conical

peak near the Teesta river, conspicuously visible from Darjeeling. On the label it is called 'Mainamuho,' but Munro evidently had good reason to write 'Mainom,' which is the commonly accepted European spelling of the mountain's name. The plant is quite distinct from *A. spathiflora*, Trin., of the North-western Himalaya.

The high-level form is represented in the Kew Herbarium by some of the other specimens which Gen. Munro has quoted. They are :

(1) that collected by T. Thomson in woods above the Islumbo Pass in Sikkim on Oct. 13, 1857. Munro gives the altitude of the locality as 11,000 ft. It was from stunted plants little more than a foot high and has panicles of 3-4 spikelets, the spikelets being few-flowered and having the empty glumes very small and rather distant below the first flower. The specimen also bears the No. 6738 of the Griffith Collection (Kew Distribution).

(2) that collected by T. Thomson on Aug. 26, 1857, at Birch Hill, Darjeeling, 6000 ft., specimens quite similar to those of (1) and noted as having culms 'pale blue' in colour. This specimen is mounted on the same sheet as (1), and I am obliged to confess that I think there must have been some mistake and that the label, properly belonging to some other plant, has got misplaced and been wrongly affixed to the sheet. Birch Hill is the end of the Darjeeling ridge and is now part of a public park and is a very unlikely locality for the high-level *A. racemosa*.

(3) that collected by Sir J. D. Hooker at Yalloong, 10,000 ft. in Eastern Nepal, Vern. 'Pat-hioo.' It bears no flower and has slender geniculate branchlets, pubescent leaves up to 10 cm. long and scarcely 1 cm. broad.

These are the chief specimens quoted by Munro, and it seems quite evident that Thomson's Islumbo Pass flowering specimen is the real type of *Arundinaria racemosa*, while at the same time the descriptions of the culms and leaves have been partly taken from Hooker's Mainom leaf specimen, which belongs to the low-level form. Since the publication of Munro's work, the high-level plant has been collected several times by Mr. G. A. Gammie and collectors deputed by the staff of the Calcutta Botanic Garden between 1887 and 1897, on the Singalila Range (the Nepal-Sikkim frontier range) above 10,000 ft., and in various places in Sikkim. When Mr. G. A. Gammie first sent me foliage specimens of this small species, I took it to be something new and gave it a manuscript name, *A. Gammieana* which was the name under which I proposed to describe it in the 'Bambuseae.' I then found I was wrong in supposing it to be distinct and that the specimens really belonged to what Munro had described as *A. racemosa*. This high-level plant has culms 60-120 cm. high and scarcely 1 cm. in diameter at base and smooth, not scabrous as in the low-level form. Both the high-level and low-level species have long rhizomes, the culms arising singly from them, so that they easily spread and grow gregariously over considerable areas. In this manner of growth they agree, so far as is known, only with *A. jaunsarensis*, Gamble of the Western Himalaya, *A. Rolloana*, Gamble of the Naga Hills in Assam and the interesting but doubtful species *A. anceps*, Mitford, which is cultivated in Europe, but of the exact country of whose

origin, though believed to be of the Kumaon Himalaya, nothing is known.

A. racemosa, Munro (which form is not stated), was reported by Mr. W. J. Bean in the *Kew Bulletin* for 1907, p. 230, to have flowered in the Temperate House at Kew in 1899, but specimens are apparently not in the Herbarium.

I have come to the conclusion that the suspicion which I held when writing the 'Bambuseae,' and the 'Manual of Indian Timbers' and which Brandis so strongly confirmed, is well founded, and that the two forms of *A. racemosa*, Munro, are really two different species. The high-level form is clearly the one whose flowers were described by Munro, and the low-level form is that called by Hooker *A. spathacea* and *A. spathiflora*. But it is not *A. spathiflora*, Trin. That is a well-known and distinct species of the Western Himalaya, so that a new name has to be found, and so I propose to call it *A. Maling*. The descriptions of the two species will now have to be revised, and I have consequently drawn up the following :

Arundinaria racemosa, Munro in Trans. Linn. Soc. xxvi. (1868) 17.

Species nana, e rhizomate subterraneo viz 5 mm. crasso culmos graciles per intervalla proferens ; ramulis foliiferis et floriferis ad nodos fasciculatis. *Culmi* erecti, 6-12 dm. longi, radicibus ad basim supra rhizoma muniti et vix 1 cm. diametro, internodiis flavis ad 10 cm. longis 1 cm. diametro teretibus nec scabris ; cataphylla straminea, glabra vel parce ad apices pubescentia, 6-10 cm. longa, 1.5-2 cm. lata, striata, ore parce ciliata et interdum cornuta, laminis anguste subulatis 0.5-1.5 cm. longis scabris ; ramuli teretes, glabri, rufescentes, saepe geniculati. *Folia* tenuia, linearilanceolata, in ramulis gracilibus ad 30 cm. longis, apice setaceo-acuminata, basi obtusa vel in petiolum brevem latum attenuata ; 3-10 cm. longa, 5-10 mm. lata ; nervi utrinque 3, minoribus circa 5-7 (5-6 per mm.) interpositis et venulis transversis conspicuis circa 5-6 per mm. ; juniora subtus pilis longis hirsuta, demum glabra ; uno margine laevia, altero scabra ; vaginae striatae, primum pubescentes demum glabrae, membrana brevi terminatae, ore cornutae et ciliis paucis longis fimbriatae ; ligula brevis, puberula. *Panicula* simplex, racemosa ; ad basim et aliquando fere ad spiculas bracteis vaginantibus longis striatis suffulta ; rhachis glabra ; spiculae 3-6, 3-5 cm. longae, pedicellis angulatis filiformibus 1-3 cm. longis ; flores in spiculis 4-6, distichi, alterni, addito interdum ultimo vacuo ; rhachillae clavatae, pubescentes, 5-6 mm. longae. *Glumae* I. et II. (vacuae) valde variabiles, minimae, acuminatae, 2-3.5 mm. longae, infra florem primum saepissime 3-4 mm. distantes ; gluma III. (florens) ovato-acuminata, pubescens, scabride-aristata, nervis 7-9 conspicuis, 9-10 mm. longa ; IV. (palea) florenti aequalis vel brevior, apice 2-mucronata, carinis apices versus extus ciliatis, nervis obscuris. *Lodiculae* 3, ovato-lanceolatae, ciliatae, basi nervosae, 1.5-2 mm. longae. *Antherae* purpureae, 5 mm. longae, apice bifidae. *Ovarium* ovoideum ; stylo brevi ; stigmatibus 3 brevibus papillois. *Caryopsis* oblongus, apice attenuatus, sulco longitudinali notatus. Gamble in Ann. R. Bot. Gard. Calcutta. vii. 9 (*in part*), t. 8, figs. 2, 5 to 13, and in Hook. f. Fl. Brit. Ind. vii. 379 (*in part*) ; Brandis Ind. Trees 664 (high-level form). *Arundinaria Gammieana*, Gamble MS.

EASTERN NEPAL: at Yalloong, 10,000 ft., Vern. 'Pat-hioo,' *J. D. Hooker* (leaves only). SIKKIM: woods above Ishunbo Pass, *T. Thomson*, Oct. 13, 1857 (*Griffith* K.D. 6738, flowers); at Singalilah, 10,000 ft., June 1887 *Dr. King's Collector* (flowers); at Saburkum 10,000 ft., March 1889, Vern. 'Miknu' *Lepcha*, 'Mheem' *Bhutia*, *G. A. Gammie's Collector* (culms and leaves); at Phalut, 10,000 ft., May 1890, *King's Collector* (culms, leaves and flowers); at Phalut 11,500 ft., May 1892, Vern. 'Miknu' *Lepcha*, *G. A. Gammie* (culms, leaves and flowers); at Jongri 12,000 ft., July 1897, *Phul Sing* for *G. A. Gammie* 10,344 (leaves); at Phalut 12,000 ft. do. do. 10,348 (flowers and leaves).

Some of the specimens above quoted are in the Herbarium at Kew, the rest of them, communicated by the Calcutta Botanic Garden or by Mr. Gammie, in my own.

Arundinaria Maling, *Gamble* sp. nov.

Frutex erectus, 3-9 m. altus, e rhizomate crasso subterraneo culmos singulos per intervalla proferens. *Culmi* graciles, erecti, fistulosi, parietibus 5 mm. diametro, internodiis superne scabris, 30-40 cm. longis, 2-3 cm. diametro; cataphylla straminea, chartaceo-coriacea, eximie striata, extus sparsim fulvo-hispida, marginibus ciliatis, ad 30 cm. longa et 10 cm. lata, supra attenuata, ore 1-2 cm. lato auriculata, et ciliis longis rigidis patentibus munita; lamina subulata, 6-7 cm. longa, erecta vel reflexa, intus scabra; ligula 1 cm. longa, eximie fimbriata. *Folia* chartacea, lineari-lanceolata, apice setaceo-acuminata, basi in petiolum brevem attenuata, utroque latere glabra, subtus glaucescentia; marginibus minutissime scabra; 5-18 cm. longa, 0.8-2 cm. lata; nervi utrinque 3, minoribus circa 6-9 (5-6 per mm.) interpositis et venulis transversis conspicuis, tessellatis, circa 3-4 per mm.; vaginae striatae, ore ciliato excepto glabrae et ibi ciliis paucis longis rigidis, circa 3-5, munitae; ligula brevis, truncata, pubescens. *Panicula* decomposita, 10 cm. longa, ad basim bracteis spathaceis superne foliaceis vaginantibus suffulta; rhachis glabra, angulata; rami et pedicelli filiformes, sinuati, 1-2 cm. longi; spiculae 10-20, 3.5 cm. longae; flores in spiculis 7-9, distichi, alterni, ultimo vacuo; rhachillae clavatae, curvatae, intus complanatae, pubescentes et ciliatae, 5-6 mm. longae. *Glumae* I. et II. (vacuae) florem inferum amplectentes, ovatae, scabride setaceo-acuminatae, I. enervis 2-4 mm. longa, II. 5-nervis 7-9 mm. longa; gluma III. (florens) etiam ovata, et scabride setaceo-acuminata, 7-9-nervis et nervulis transversalibus, 1-1.2 cm. longa; IV. (palea) apice bifida, ad carinas ciliata, intra carinas 2-3-nervis et nervulis paucis transversalibus, ad latera 1-2-nervis, 7-8 mm. longa. *Lodiculae* 3 ovatae, obtuse acutae, ciliatae, basi nervosae, 2-2.5 mm. longae. *Antherae* luteae, 5-6 mm. longae, apice bifidae. *Ovarium* ovoideum, stylo brevi gracili et stigmatibus 3 longis plumosis. *Caryopsis* nondum visa. *A. racemosa*, Munro in Trans. Linn. Soc. xxvi. 17 (*in small part only*); Gamble in Ann. R. Bot. Gard. Calc. vii. 9 (*in part*), t. 8 figs. 1, 3, 4, 14, and in Hook. f. Fl. Brit. Ind. vii. 379 (*in part*); Brandis Ind. Trees 664 (low-level form).

SIKKIM: Mount Tonglo, 9000 ft., May 23 1904, Vern. 'Maling' *Nep.*, *B. B. Osmaston* (flowers and leaves); at Mainom,

8000 ft., Dec. 27, 1848, Vern. 'Pummoon' *Lepcha*, Hook. f. & Th. (leaves); Vern. 'Phyong' *Bhutia*, Oct. 5 1868, Kurz (leaves); also at various other places in British Sikkim, G. A. Gamble, J. S. Gamble and others, in leaf only.

Thus, it will be seen that the number of Sikkim species of the genus *Arundinaria* must be raised to 10. *A. Maling* undoubtedly comes very near to *A. Pantlingi*, and at one time I thought they might be identical, but the latter species has long loose much branched panicles, longer and narrower spikelets, glumes with more conspicuous awns and strongly ciliate leaf sheaths, while in *A. Maling* the panicles are quite short and compact, the spikelets broad, the glumes less awned and the leaf sheaths glabrous at the margins. I have made an attempt to give in an analytical key a guide to the ten Sikkim species, which may perhaps be of use to botanists in the Eastern Himalaya. I would have liked to base the key chiefly or even wholly upon the leaves, but the difficulty is that the leaves are so variable according to whether they are taken from upper branches or from new shoots and so on, that mere size goes for very little. In some species the culm sheaths afford excellent characters, but they are not always available.

Leaves with conspicuous transverse veinlets.

Inflorescence branches without conspicuous broad sheathing bracts;

Dwarf plants reaching scarcely 4 ft. in height; spikelets few, rarely 6, in a short raceme with narrow sheaths below 1. *A. racemosa*.

Culms tall, reaching 12 or even sometimes 30 ft. in height; spikelets many, more or less paniculate—

Panicles compact, terminal, about 4 in. long with 10-20 spikelets 2. *A. Maling*.

Panicles loose, terminal and axillary with many spikelets—

Culm-nodes without spines ... 3. *A. Pantlingi*.

Culm-nodes spinous ... 4. *A. Griffithiana*.

Inflorescence branches with conspicuous broad sheathing bracts, each enclosing 3-5 spikelets with conspicuously aristate glumes 5. *A. aristata*.

Leaves with no or very few transverse veinlets—

Inflorescence branches without sheathing bracts—

Culms tall, bluish-green; leaves rather large; spikelets of only 1 flower 6. *A. Hookeriana*.

Culms rather small—

Leaves soft, rather large; spikelets 4- to 6-flowered in a tall close panicle; leaf sheaths not ciliate

7. *A. polystachya*.

Leaves stiff, moderately large; spikelets 3-5-flowered in slender panicles; leaf sheaths ciliate

8. *A. intermedia*.

Inflorescence branches with sheathing bracts; spikelets 2-4-flowered; leaves soft 9. *A. Falconeri*.

Inflorescence not known; leaves very narrow, linear

10. *A. suberecta*.

XIV.—NIGERIAN FUNGI.

E. M. WAKEFIELD.

In the following list particulars are given of an interesting collection of fungi made in Northern Nigeria by Dr. J. W. Scott Macfie, and forwarded to Kew for identification by Mr. Carleton Rea, Hon. Sec. of the British Mycological Society. One new species, *Metraria brevipes*, is described, and a very rare and beautiful fungus, *Hexagonia niam-niamensis*, was also represented in the collection.

The numbers in brackets are the field numbers given by Dr. Macfie.

AGARICACEAE.

Omphalia reflexa, Bres. in Bull. Soc. Myc. Fr. Vol. vi (1890), p. xxxiv.

A single specimen, having the pileus remarkably lobed at the margin, but otherwise agreeing exactly with the type description and figure.

On the ground, Baro, Sept. 11, 1910. (5E.)

Lentinus Zeyheri, Berk., in Hook. Lond. Journ. of Bot., vol. ii, 1843, p. 514.

L. capronatus, Berk., l.c. p. 513.

Doka to Katai, Dec. 11, 1910.

Lentinus flavidus, Mass., in Kew Bull. 1901, p. 163.

Possibly the same as *L. Tuber-regium*, Fr.

On sandy ground, Baro, Sept. 12, 1910. (6A.)

Lenzites applanata, Fr., Epicr. p. 404.

Syst. Myc. i, p. 335, *L. Palisoti*, Fr., *Daedalea amanitoides*, Pal., Fl. Ow. t. 25.

Ayangba, Jan. 11, 1911; Kurumculya to Kwakow, Dec. 5, 1910; Dekina, Jan. 12, 1911; Zungeru, Mar. 2, 1911.

Schizophyllum commune, Fr., Syst. Myc. i, p. 333.

On logs; Wooding station, 22 miles from Baro, on the Baro-Minna line, Sept. 3, 1910. (4E in part); Baro, Sept. 11, 1910. (5F); Kogin Seratin Pawa, Dec. 8, 1910; Zungeru, Feb. 20, 1911.

Metraria brevipes, Wakefield, sp. nov.

Pileus e globoso expansus, fere planus, pallide umbrinus, squamis crassis obscurioribus ornatus, 5 cm. latus, margine radiato-striatus; stipes concolor, basi incrassatus, 5 cm. longus, usque ad 2 cm. crassus, glaber, primo fartus dein fistulosus; annulus crassus, pendens; lamellae confertae, postice angustiores, e roseo fulvescentes, liberae vel leviter adnexae; sporae roseae, ellipsoideae, lateraliter apiculatae, 9-10 × 7-7.5μ.

No volva is present on the specimens forwarded, but its existence is inferred from the smooth, blunt base of the stem, and the appearance of the scales on the pileus.

On the ground, Baro, Sept. 13, 1910. (6B.)

Panaeolus fimicola, Fr., Syst. Myc. i, p. 301.

On horse-dung, Minna, Aug. 22, 1910.

Psathyrella disseminata, Pers., Syn. p. 403. Fr. Syst. Myc. i, p. 305.

On wood; Minna, Sept. 23, 1910. (7A); Wooding station, 22 miles from Baro, on the Baro-Minna line, Sept. 3, 1910. (4E in part.)

POLYPORACEAE.

Polyporus Tricholoma, *Mont.*, in *Ann. sc. nat.*, 2 sér., viii, 1837, p. 365, and in *R. de la Sagra*, *Hist. Cuba*, p. 411, t. 17, f. 1.

Known from Cuba, Central and S. America, and Australia, but not previously from Africa. The African specimens have the stem slightly thickened at the base, but do not appear to be specifically distinct.

Baro, Sept. 24, 1910. (6E.)

Polyporus Hollandii, *Mass.* in *Kew Bull.* 1901, p. 163.

Originally described from a single specimen sent to Kew from Old Calabar. The specimen of which Dr. Macfie forwarded a portion was evidently much larger, the dimensions given being:—length, $11\frac{1}{2}$ in., breadth, 9 in., maximum thickness, 5 in.

On a stump, Zungeru, April 10, 1911.

Fomes lucidus, *Fr.*, Nov. *Symb.* p. 61. *Syst. Myc.* i, p. 353.

Both the typical form and the yellow, unpolished variety which appears to be common in Africa were received. The latter has been sometimes referred to the American species, *F. Curtisii*, *Berk.*, but it differs from this in having dark brown, not pale flesh.

On stumps; Katonkarifi, Dec. 26, 1910; Zungeru, Mar. 2, 1911, &c.

Fomes ligneus, *Cke.* in *Grev.* vol. xiii, p. 119, 1884.

Ankpa to Lafia (Bassa), Jan. 8, 1910.

Fomes australis, *Fr.*, *El.* p. 108.

i. No locality given; ii. Ankpa, Jan. 7, 1911.

Polystictus xanthopus, *Fr.*, *Obs.* 2, p. 255.

On trees, between Evua and Deni, Dec. 24, 1910; Lafia to Ogumi (Bassa), Jan. 10, 1911.

Polystictus Holstii, *P. Henn.*, *Pilz. Ostaf.*, p. 57, in *Engler*, *Die Pflanzenwelt Ostaf.*

On trees; Zungeru, Feb. 20, 1911; Kurumculya to Kwakow, Dec. 5, 1910.

Polystictus albo-cervinus, *Berk.* in *Hook. Journ.* 1856, p. 234. Dec. n. 583.

Originally described from Brazil, but appears to be fairly common in Africa.

On a tree, Agwacha to Oda (Bassa), Jan. 5, 1911.

Polystictus sanguineus, *Mey.*, *Esseq.* p. 304. *Boletus sanguineus*, *Linn. Sp. Pl.* ii, p. 1646.

On trees, Ogusw (Nassarawa), Dec. 30, 1910; Ankpa to Lafia (Bassa), Jan. 8, 1910; 20 miles from Baro, on the B.K.R. line, Sept. 3, 1910; Baro, Sept. 11, 1910. (5D.)

Polystictus leoninus, *Kl.* in *Linnaea* viii, p. 486.

Kurumculya to Kwakow, Dec. 5, 1910; 20 miles from Baro, on the B.K.R. line, Sept. 3, 1910; 22 miles from Baro, on the Baro-Minna line, Sept. 3, 1910.

Polystictus Persoonii, *Fr.* in *Cooke*, *Pracc.* n. 850, in *Grev.* vol. xiv, p. 85.

Kogin Seratin Pawa, Dec. 8, 1910.

Polystictus lanatus, Fr., Epicr. p. 490.

On trees; between Dogu and Wopa, Gurara river, Dec. 20, 1910.

Polystictus occidentalis, Kl. in Linnaea viii, p. 486.

22 miles from Baro, on the Baro-Minna line. Sept. 3, 1910; (4E in part); Aiya gwa or Aiyamba, Jan. 11, 1911; Kurumculya to Kwakow, Dec. 5, 1910.

Polystictus membranaceus, Berk., Fung. Brit. Mus. p. 378, tab. X, fig. 7.

Between Mama and Evua by Gurara river, Dec. 23, 1910.

Trametes Hystrix, Che. in Grevillea ix, p. 98.

Zungeru, April, 1911.

Trametes cingulatus, Berk., Dec. n. 441.

A common and variable plant in Africa, Australia and the East. According to Mr. C. G. Lloyd, *Trametes picta*, Berk., *Polystictus albidus*, Mass., and *Polyporus argentatus*, Cke, are synonyms.

On trees by the wayside, Ankpa to Lafia (Bassa), Jan. 8, 1910; between Kogin Seratin Pawa and Doka, Nov. 30, 1910; Doka to Katai, Dec. 1, 1910.

Trametes ochroleuca, Lév., in Ann. sc. nat., 3 sér. v, 1846, p. 145.

The *Trametes* form of the polymorphic *Sistotrema ochroleucum*, Lév. (Lloyd, Syn. Hex., p. 31.)

Abaji Kolo (Bassa), Jan. 3, 1910; Ankpa to Lafia (Bassa), Jan. 8, 1910.

Hexagonia Klotzschii, Berk., Exot. Fungi p. 383, n. 2.

Apparently a common plant in Africa, but confined to that continent. According to Lloyd (Syn. Hex. p. 7), *H. Klotzschii* is a synonym of *H. hirta*, Pal., *H. crinigera*, Fr., and *Trametes crassa*, Lév.

On trees, between Dogu and Wopa (Gurara river), Dec. 20, 1910.

Hexagonia discopoda, Pat. et Har. in Bull. Soc. Myc. Fr. Vol. ix, 1893, p. 209. Probably the same as *H. tricolor*, Fr., of which no specimen is known (Lloyd, Syn. Hex. p. 26).

Between Evua and Deni (Gurara river), Dec. 24, 1910; Kurumculya to Kwakow, Dec. 5, 1910.

Hexagonia niam-niamensis, P. Henn. in Engl. Jahrb. xiv, p. 348.

This is the most interesting plant of the whole collection. It is a beautiful *Hexagonia* with large pores, quite distinct from any other known species, and has previously been known only from a single specimen, which is at Berlin. Dr. Macfie found two good specimens, growing on bamboo.

Kurumculya to Kwakow, Dec. 5, 1910.

THELEPHORACEAE.

Stereum elegans, Mey., Esseq. p. 305, Fr. Epicr. p. 545.

Minna, Oct. 5, 1910. (7 B.)

CLAVARIACEAE.

Pterula capillaris, Lév. in Ann. sc. nat., 3 sér., ii, 1844, p. 208.

Baro, Sept. 24, 1910. On grass of an old roll used by the natives for placing under a load on the head.

Spores 11-12 × 6-7μ, most 12 × 7, ellipsoid, apiculate at base.

TREMELLACEAE.

Guepinia spathularia, *Fr.*, Elench. ii, p. 32.
On a stump, Baro, Sept. 24, 1910. (6D.)

SPHAERIACEAE.

Xylaria polymorpha, *Grev.*, Flor. Edin. p. 35.
Zungeru, Mar. 2, 1911.

Xylaria grammica, *Mont.* in Ann. sc. nat., 2 sér., xiii, 1840,
p. 341. t. 9, f. 1.

Aiya gwa or Aiyamba, Jan. 11, 1911.

Poronia ustorum, *Pat.* in Bull. Soc. Myc. Fr. iii, p. 175.

The Nigerian specimens have spores $10-12 \times 5-6\mu$, (most $11 \times 6\mu$), instead of $8-10 \times 4-5\mu$, the measurements given by Patouillard. In all other respects, however, they agree with the description of *P. ustorum*.

On grass stubble, Baro, Sept. 10, 1910.

Daldinia concentrica, *Ces. et De Not.*, Schema Sf. it. in Comm. Soc. Critt. It., i., p. 198.

On stumps; Minna, Aug. 18, 1910. (3C); Wooding station, 22 miles from Baro, on the Baro-Minna line, Sept. 3, 1910. (4E in part.)

MYXOMYCETES.

Stemonitis splendens, *Rost.*, Mon. p. 195.

On wood; 22 miles from Baro, on the Baro-Minna line, Sept. 3, 1910. (4E in part.)

XV.—CONTRIBUTIONS TO THE FLORA OF SIAM.

ADDITAMENTA.

Dasymaschalon sootepense, *Craib* [Anonaceae-Unoneae]; a *D. Blumei*, Finet et Gagnep., foliis tenuioribus longius petiolatis, fructuum articulis multo longioribus recedit.

Arbuscula ad 7.5 m. alta (ex *Kerr*); ramuli primo pilosuli, mox glabri vel subglabri, cortice brunneo vel fusco-brunneo irregulariter striato obtecti. *Folia* oblanceolato-oblonga vel oblonga, apice breviter acuminata, acuta, basi late cuneata vel subrotundata, 9-19.8 cm. longa, 2.5-6 cm. lata, tenuiter chartacea, supra matura glabra, subtus parvisissime appresse setulosa, glauca, nervis lateralibus utrinque 9-10 intra marginem arcuatis cum costa supra leviter impressis subtus prominentibus; petioli 1 cm. longitudinis vix attingentes, supra sulcati, indumento ramulorum. *Flores* plerumque axillares, solitarii, pedicellis apicem versus leviter incrassatis ad 1.5 cm. longis basi breviter bracteatis et paullo supra basin minute bracteolatis suffulti. *Sepala* 3, deltoidea, acuta, 3 mm. longa, 1.5 mm. lata, extra appresse ferrugineo-pubescentia. *Petala* ad 4 cm. longa et 1.5 cm. lata, utrinque sed intra parcius appresse pilosula. *Fructus* lomentaceus, ad 6 cm. longus, pedicello circiter 1 cm. longo suffultus, rugulosus, parce appresse pilosulus; semina straminea, 1.8 cm. longa, vix 5 mm. diametro, hilo inferiore.

Chiengmai, in evergreen jungle on Doi Sootep, 1050-1260 m., *Kerr*, 1364, 1777.

Platymitra siamensis, Craib [Anonaceae-Mitrephoreae]; a *P. macrocarpa*, Boerl., foliis longioribus angustioribus basi cuneatis vel subobtusis, pedicellis crassioribus, antheris filamentis longioribus, bacca ovoidea, seminibus vix 2 cm. longis 1 cm. crassis differt.

Arbor alta (ex *Kerr*), inflorescentia excepta glabra; ramuli cortice brunneo vel fusco-brunneo lenticellato irregulariter striato obtecti. *Folia* lanceolata, apice acuminata, obtusiuscula, basi cuneata, subobtusata, 5–13 cm. longa, 1.5–2.5 cm. lata, rigide chartacea, supra nitida, subtus subnitida, nervis lateralibus utrinque circiter 12 intra marginem arcuatis supra conspicuis subtus prominulis; petioli circiter 5 mm. longi, supra canaliculati. *Flores* fasciculati, fasciculis ex axillis foliorum delapsorum plerumque ortis; alabastra depressa-globosa, appresse pubescentia; pedicelli 1 cm. longi, crassiusculi, basi breviter bracteati, apicem versus bracteola parva instructi. *Calyx* 1.5 mm. altus, extra ferrugineo-pilosulus, lobis 3 rotundatis. *Petala* 3 exteriora valvata, satis crassa, circiter 3 mm. longa, 3 mm. lata, extra appresse breviter ferrugineo-pubescentia, intra glabra, 3 interiora apice valvata, basi aperta extra breviter appresse pubescentia. *Stamina* circiter 20. *Ovaria* 2, albo-hirsuta. *Bacca* ovoidea, circiter 7 cm. longa, 5 cm. diametro; semina 8, 1.8 cm. longa.

Sriracha, Nawng Kai Ploi, in evergreen jungle, 90 m., *Kerr*, 2125.

Siamese name, Hüm Chang (ex *Kerr*).

There are no open flowers in the specimens received and the above description of the flowers is taken from buds.

Miliusa cuneata, Craib [Anonaceae-Miliuseae]; a *M. sinensi*, Finet et Gagnep., foliis longioribus basi cuneatis, ovulis solitariis recedit.

Suffrutex ad 4.5 cm. altus (ex *Kerr*); ramuli primo fulvo-tomentelli, mox puberuli, ad 4 mm. diametro, cortice brunneo lenticellato. *Folia* oblanceolata vel late oblanceolata, apice acuminata, acuta vel obtusa, basi cuneata, 4–14 cm. longa, 1.5–4.4 cm. lata, chartacea, supra costa tantum breviter pubescentia, subtus primo costa densius fulvo-pubescentia, cetera pilosula, matura molliter puberula, nervis lateralibus utrinque 12–15 intra marginem arcuatis pagina utraque subconspicuis; petioli 3–4 mm. longi, indumento ramulorum. *Inflorescentia* pauciflora, plerumque ex axillis foliorum delapsorum; pedicelli ad 2.7 cm. longi, sub anthesin graciles, postea paullo incrassati, basi minute bracteati et circiter 7 mm. e basi minute bracteolati. *Sepala* 3, deltoidea vel late lanceolata, acuta, vix 2 mm. longa, ad 1.25 mm. lata, breviter ciliata, pauperrime pubescentia. *Petala* exteriora sepalis conformia, circiter 3.5 mm. longa, 0.75 mm. lata, indumento ut sepalis, interiora viridia (ex *Kerr*), 1.2 cm. longa, 6 mm. lata, concava, basi parum sacciformia, intra puberula. *Stamina* circiter 6-seriata, filamentis brevibus. *Ovaria* parce pubescentia, 1.25 mm. alta, stylo 0.75 mm. longo; ovula solitaria, basilaria.

Chiengmai, in evergreen jungle on Doi Sootep, 900 m., *Kerr*, 1837.

Xylosma brachystachys, Craib [Bixaceae-Flacourtieae]; a *X. longifolia*, Clos, foliorum nervis paucioribus, inflorescentia reducta recedit.

Suffrutex sarmentosus, dioicus, glaber, in exemplo uno tantum spina solitaria axillari 4 mm. longa visa; ramuli graciles, cortice primo pallide brunneo mox cinereo pauci-lenticellato obtecti. *Folia* plerumque oblonga vel oblongo-ob lanceolata, apice acuminata, plerumque caudatim, mucronulata, basi cuneata vel late cuneata, 3·5–14·5 cm. longa, 1·2–5 cm. lata, rigide chartacea, nervis lateralibus utrinque 5–7 iis basalibus obliquis subrectis exceptis arcuatis supra conspicuis, subtus cum costa prominentibus, nervis transversis uti lineis subparallelis pagina utraque conspicuis, margine, basi acumineque exceptis, serrata; petioli ad 4 mm. longi, supra canaliculati, sicco pallide virides. *Inflorescentia* ♂ petiolos subaequans vel paullo superans; pedicelli 1·5 mm. longi, glabri, basi parvibracteati. *Calyxis* lobi 5, acuminati, 1·25 mm. longi, 1–1·5 mm. lati, glabri. *Stamina* numerosa, basi disco crenulato cincta, filamentis ad 1·75 mm. longis. *Inflorescentia* ♀ petiolos subaequans; pedicelli vix 1 mm. longi, glabri, bracteis parvis. *Calyx* 1·5 mm. altus, ovario appressus. *Ovarium* 0·75 mm. altum, basi disco cinctum, placentis duobus, pauciovulatum; stylus validiusculus, ovario subaequaltaltus.

Chiengmai, in evergreen jungle on Doi Sootep, 660 m., *Kerr*, 1821.

Decaschistia siamensis, *Craib* [Malvaceae-Hibisceae]; a *D. crotonifolia*, Wight et Arn., foliis tenuioribus supra scaberulis, floribus fructibus seminibusque minoribus recedit.

Fruticulus ad 1·2 m. altus (ex *Kerr*); ramuli primo densius tomentoso-pubescentes praetereaue pilis stellatis rigidioribus longioribus passim instructi. *Folia* late ovata, ovata vel ovato-lanceolata, apice acuta, basi rotundata vel obtusa, interdum subcordata, 6–14 cm. longa, 1–6·5 cm. lata, tenuiter chartacea, supra breviter, tenuiter-stellato-pubescentia praetereaue ob pilos paucos stellatos longiores et multo rigidiores scaberula, subtus densius, molliter tomentosi, margine distanter, irregulariter serrata nisi parte basali integra, e basi trinervata, nervis secundariis (e costa ortis) utrinque 4–6 supra conspicuis subtus prominentibus nervis transversis subtus prominulis costa subtus basin versus glandula ad 4 mm. longa instructa; petioli 1–3 cm. longi, dense tomentosi; stipulae e segmentis tribus subaequilongis ad 1·2 cm. longis constituae, caducae. *Flores* axillares, solitarii vel gemini, pedicellis usque ad 7 mm. longis suffulti. *Bracteolae* 10, aequales, lineares, acutae, ad 8 mm. longae et 1·75 mm. latae, extra tomentosae, intra subsericeae. *Calyx* sub anthesin circiter 1 cm. longus, fere ad medium lobatus, lobis late deltoideis acuminatis acutis 5 mm. latis extra hirsutis intra superne appresse pilosulis distincte nervatis; calyx infrutescens parum major. *Corolla* 4 cm. longa, sulphurea nisi basi atropurpurea (ex *Kerr*). *Stamina* gynoeceumque generis. *Capsula* calycem vix aequans, dense hirsuta. *Semina* 3·5 mm. longa, glabra.

Sriracha, in scrub jungle near the sea, *Kerr*, 2105.

Helicteres Gagnepainiana, *Craib* [Sterculiaceae-Helictereae]; ab *H. Geoffrayi*, Gagnep., ramulis foliisque haud glabris, inflorescentiae rhachi glanduloso facile distinguenda.

Suffrutex sarmentosus, circiter 1 m. altus (ex *Kerr*); ramuli cinereo-albidi, pilis minutis stellatis confertis diu persistentibus

obtecti. *Folia* lanceolata, apice indistincte acuminata, mucronata, basi cuneata vel late cuneata, obtusiuscula, 4·5-11·5 cm. longa, 1·3-3 cm. lata, chartacea vel tenuiter chartacea, integra, supra fusca, nisi costa pilis minutis stellatis tecta glabra, subtus pallida, indumento ut ramulis, e basi trinervata, nervis secundariis (e costa ortis) utrinque 6-7 supra subconspicuis subtus prominentibus nervis transversis subtus prominulis; petioli graciles, ad 7 mm. longi, indumento ut ramulis; stipulae 5 mm. longae, 0·75 mm. latae, acutae. *Inflorescentia* brevis, axillaris, rhachi glandulis nigris sessilibus instructo; pedicelli 2·5 mm. longi; bractee ad 4 mm. longae. *Calyx* extra minute stellato-pubescent; tubus 4 mm. longus; lobi lanceolati, acuti, 2 mm. longi, 1 mm. lati, intra minute stellato-pubescentes. *Petala* purpurea (ex Kerr), 8 mm. longi, 1·5 mm. lati. *Androphorium* glabrum, circiter 5 mm. longum.

Sriracha, Nawng Kaw, by side of railway track, 30 m., Kerr, 2046.

Named in compliment to Monsieur Gagnepain, to whom I am deeply indebted for comparing this plant and several others of Dr. Kerr's collection with the species described by him in the Flore Generale de l'Indo-Chine.

Pterospermum littorale, Craib [Sterculiaceae-Helicterae]; a *P. grewiaefolio*, Pierre, floribus majoribus distinguenda.

Arbor parva (ex Kerr); ramuli primo albido-vel pallide rufo-stellato-tomentelli, mox glabri, cortice fusco reticulato-striato obtecti. *Folia* ambitu plerumque oblonga, apice acuminata, acuta, basi inaequalia, truncato-cordata vel latere altero rotundato vel truncato altero late cuneato, 4·5-12 cm. longa, 2-5·4 cm. lata, chartacea, supra glabra, subtus cinereo-tomentella, margine integra vel irregulariter lobata, e basi trinervata vel sub-5-nervata, nervis lateralibus utrinque 6-8 supra leviter impressis subtus prominulis, nervis transversis supra vix conspicuis subtus ob pilos plus minusve delapsos conspicuis; petioli 1 cm. longitudine vix attingentes, indumento ut foliorum pagina inferiore diu persistente. *Flores* axillares, solitarii; pedicelli validi, ad 8 mm. longi et fere 4 mm. crassi, brunneo-tomentelli. *Sepala* 5, linearia, acuta, 7 cm. longa, 7 mm. lata, extra brunneo-tomentella, intra subflavida, pilis rigidiusculis ascendentibus tecti. *Petala* 5, 6·5 cm. longa, apice 1·7 cm. lata, basi in unguem attenuata, parum curvata, extra breviter stellato-pubescentia. *Androphorium* vix 1 cm. longum, glabrum. *Stamina* circiter 15, in fasciculas cum staminodiis alternantes disposita; filamenta circiter 2 cm. longa, ad partem trientem in fasciculas connata; staminodia 5, circiter 5 cm. longa, superne incrassata, pilis paucis minutis stellatis instructa. *Stylus* 5 cm. longus, inferne stellato-pubescent; ovarium 6 mm. altum, albobirsutum.

Sriracha, by beach, Kerr, 2097.

Euonymus similis, Craib [Celastraceae-Celastreae]; ab *E. glabro*, Roxb., floribus majoribus, petalis fimbriatis recedit.

Arbuscula circiter 7·5 m. alta (ex Kerr); ramuli glabri, primo subquadrangulares, viridi-straminei, mox teretes, cortice rubro-brunneo obtecti. *Folia* plerumque oblanceolata vel obovato-oblanceolata, apice acuminata, acutiuscula vel obtusa, basi cuneata,

7-12.5 cm. longa, 3-6 cm. lata, coriacea, utrinque glabra, margine revoluta superne serrata, nervis lateralibus utrinque 6-8 supra conspicuis subtus prominulis nervis transversis utrinque plerumque subconspicuis; petioli ad 1 cm. longi, supra canaliculati. *Cymae* axillares, dichotomae; pedunculi communes ad 5.5 cm. longi, glabri; pedicelli circiter 7 mm. longi, inferne articulati. *Sepala* exteriora rotundata, circiter 2 mm. diametro, interiora transverse oblonga, 3 mm. longa, 5 mm. lata, omnia ciliata. *Petala* 5, oblongo-cuneata, superne fimbriata, 6 mm. longa, 5 mm. lata, glabra. *Filamenta* circiter 2.5 mm. longa. *Stylus* obtusus, 1.5 mm. altus. *Ovula* 2, superposita. *Fructus* vix 1 cm. altus, pallide viridis vel brunescens. —*E. sp. n.*, Craib, Kew Bull. 1911, p. 29.

Chiengmai, in evergreen jungle on Doi Sootep, 720-1200 m., *Kerr*, 649, 736, 736a.

Euonymus sootepensis, *Craib* [Celastraceae-Celastreae]; ab affini *E. Griffithii*, Kurz, foliis multo latioribus nervis tenuioribus recedit.

Caules scandentes, quadrangulares vel plus minusve alati, cortice viridi-stramineo obtekti, glabri. *Folia* late obovata, elliptica vel subrotundata, apice breviter acuminata, acuta, basi rotundata vel subcordata, 3-7 cm. longa, 1.7-5.6 cm. lata, chartacea, vel rigide chartacea, sessilia vel subsessilia, utrinque glabra, margine serrulata vel crenulato-serrata, nervis lateralibus utrinque 4-5 pagina utraque subprominulis, supra fusco-subtus pallide viridia. *Cymae* ad 7-florae, axillares, solitariae, et praeterea plerumque duobus decussatis suboppositis circiter 3 mm. supra axillas additis; pedunculus communis 2 cm. longitudine paullo superans, glaber, basi bractea decidua vix 3 mm. longa brunnea instructus; pedicelli vix 5 mm. longi. *Calyx* ad medium lobatus, lobis apice rotundatis 1.25 mm. longis vix 2.5 mm. latis pauperime ciliolatis. *Petala* 4, viridia (ex *Kerr*), subrotundata, 3.5 mm. diametro, subintegra. *Filamenta* circiter 0.5 mm. longa. *Stylus* 0; ovula pendula.

Chiengmai, in evergreen jungle on Doi Sootep, 900 m., *Kerr*, 1835.

Indigofera laxiflora, *Craib* [Leguminosae-Galegeae]; ab *I. subulata*, Vahl, foliolis majoribus numerosioribus, floribus fere duplo majoribus, leguminibus haud reflexis, ab *I. cylindracea*, Wall., foliolis majoribus leguminibus longioribus, ab *I. leptostachya*, DC. foliolorum membranaceorum forma recedit.

Fruticulus flaccidus, vix 1 m. altus (ex *Kerr*); caules primo parce appresse brunneo-hirsuti, mox glabri, stramineo-vides nisi inferne rubrescentes. *Folia* imparipinnata, ad 12 cm. longa, petiolo circiter 1.5 cm. longo suffulta, rhachi supra canaliculato; foliola opposita, utrinque 4-6, plerumque oblongo-obovata, apice rotundata, mucronata, basi cuneata vel late cuneata, ad 4 cm. longa et 2.3 cm. lata, terminale a lateralibus paullo ultra 1 cm. distans, membranacea, utrinque pilis medio-fixis brevibus paucis albis nisi subtus interdum brunneis instructa, petiolulis circiter 1.5 mm. longis suffulta; stipulae deciduae, circiter 2 mm. longae; stipellae ad 1 mm. longae. *Racemi* axillares, ad 15 cm. longi, pedunculo communi ad 5 cm. longo suffulti. *Bractae* sub anthesin deciduae, 1.5 mm. longae. *Pedicelli* ad 5 mm. longi, ut rhachi pilis paucis appressis brunneis instructi. *Calyx* extra parce appresse brunneo-pubescent; tubus 1.75 mm. longus; lobi lanceolati, acuti, ad 1 mm. longi. *Corolla* purpurea

(ex *Kerr*); vexillum subellipticum, 8 mm. longum, 6 mm. latum, ungui 1 mm. longo, extra breviter appresse albo-pubescentis; alae angustae, vexillo aequilongae; carina alas paullo superans. *Ovarium* circiter 8 mm. longum et 0.3 mm. latum, glabrum, multiovulatum. *Legumen* ad 4.3 cm. longum, 1.5 mm. latum, acuminatum, suturis incrassatum, glabrum.

Chiengmai, in open grassy jungle on Doi Sootep, 1500 m., *Kerr* 1388, 1978.

Tephrosia (*Brissonia*) *Kerrii*, *Drummond et Craib* [Leguminosae-Galegeae]; *T. vestitae*, Vog., similis sed floribus leguminibusque multo majoribus, necnon leguminis indumento valde fortiore facile distinguenda.

Suffruticulus caulibus circa bimetralibus erectis rigidis superne fistulosis sub supremam inflorescentiam 2.5 mm. diametro angulatis et leniter sulcatis pilis satis robustis ascendentibus laxe adpressis demum fulvescentibus vestitis. *Folia* imparipinnata, foliolo terminali lateralibus aliquantulo majore; foliola utrinque 5-8, oblongo-lanceolata, breviter sed distincte mucronata, usque ad 7.75 cm. longa, paullo ultra 17 mm. lata, supra olivacea, glabrata, minute sed distincte reticulata, subtus pilis subargenteis satis longis mollioribus adpressis dense vestita, costa necnon margine pilis mox fulvescentibus instructa, nervis primariis circa 3 mm. inter se distantibus leniter arcuatis, secundariis secus primarios parallelis multo obscurioribus; petioluli vix 2 mm. longi, basi pulvinati, inaequaliter hirsuti. *Inflorescentiae* juveniles strobiliformes, circa 20 mm. longae, 10 mm. diametro, denique sub anthesin ad 10 cm. longae; bractae anguste lanceolatae, argute cuspidatae, 5 mm. longae, 2 mm. (ciliis exclusis) latae, cuspi lineari-subulata circa 5 mm. longa, dorso villosissimae, ad marginem eleganter ciliatae, interne venis paucis satis obviis et pilis candidis adpressis sparse ornatae, caducae; flores rhachidis obscure flexuosi ad nodos singuli insidentes, pedicellis valde villosis post anthesin 6 mm. longis suffulti. *Calyx* extra pilis subasperis 1 mm. longis fulvescentibus laxe adpressis obsitus; tubus late poculiformis, 4 mm. diametro; lobi anguste deltoidei, anterior prope 5 mm., ceteri vix 3 mm. longi, omnes circa 2 mm. basi lati, intra fusci et minute puberuli. *Vexillum* ovato-cordatum, apice breviter emarginatum, basi cuneatum, 2.2 cm. longum, 1.5 cm. latum, in stipitem angustum imo saccatum infra involutum, venis flabellatim dispositis, dorso convexe carinatum, pilis robustis longis fulvis subadpressis vestitum, intra omnino glabratum; alae carinam vix superantes, ei forma similes sed apice obscurissime falcatae, venis satis conspicuis inter se innectis pulchre notatae, margine superiore supra unguem manifeste gibbosae; carina margine anteriore 10 mm. inferiore vix 19 mm. longa, apicem versus obtuse et brevissime rostrata, leniter falcata. *Legumen* 10 cm. longum, 7.5 mm. latum, pilis longis fulvescentibus mollibus prorsus directis vestitum, parte inferiore plus minusve arcuatum, sub apicem margine anteriore in rostrum validum 2.5 mm. longum curvatum abeunte unde exoritur stylus subpersistens, abrupte geniculatus, inferne glaber, superne unilateraliter insigne barbatus.

Chiengmai, in evergreen jungle on Doi Sootep, 960 m., *Kerr*, 1382.

Distr. Yunnan, Szemao, 1500 m., *Henry*, 12715.

Tephrosia (*Brissonia*) *repentina*, *Drummond et Craib* [Leguminosae-Galegeae]; e grege *T. tinctoriae*, Pers. (sensu stricto), ab illa necnon a *T. coccinea*, Wall., propter formam et indumentum foliolorum, a *T. Heyneana*, Wall., propter multo majores flores et legumina facile distinguenda; a *T. senticosa*, Pers. (vera), cui omnium maxime affinis, foliolis majoribus oblongo-lanceolatis vel oblongo-obovatis nec oblongo-cuneatis apice obtusis vel acutis nunquam retusis supra obscure nec conspicue striatis, legumine fere duplo longiore valde pubescente aliisque notis bene dignoscitur.

Suffruticulus 30–70 cm. altus, caule circiter 2 mm. diametro obscurius angulato irregulariter sulcato pilis subargenteis mox fulvescentibus subadpressis munito. *Folia* imparipinnata, foliolo terminali lateralibus aliquantulo majore, rhachi adpresse piloso basi inconspicue pulvinato 3.5–7.5 cm. longo; foliola utrinque 3–5, oblongo-lanceolata vel oblongo-obovata, apice obtusa vel acuta, cuiusque jugi superne gradatim majora, infima 4.5 cm. longa, 7 mm. lata, suprema ad 4.5 cm. longa et vix 2 cm. lata, supra cinereo-olivacea, ad venas nebuloze fusco-maculata, minute reticulata, glabra nisi nervis lateralibus villos paucos longos candidos sparsissime praebentibus, subtus pilis subargenteis leniter adpressis densius vestita, ad costam prominentem pilis longioribus subpatentibus ad marginem subaureis prorsus directis ornata, nervis omnibus obscuris lateralibus inter se circiter 3.5 mm. distantibus, petiolulis pilis ascendentibus pallide aureis hirsutis suffulta. *Flores* 1–4, terminales vel axillares; bracteae sericeo-canescens; bracteolae obscuriores, caducae; pedicelli (maturante legumine) vix 4 mm. longi. *Calycis* tubus subpoculiformis, circiter 3 mm. diametro, extra pilis sericeo-canescens laxe adpressis vestitus, intra glaber, lobi angustissime deltoidei, anterior circa 4 mm. longus, ceteri circa 2 mm. longi et 1 mm. lati, extra pilis demum subaureis obsiti. *Vexillum* brunneum (ex *Kerr*) circiter 19 mm. longum, medio argute sulcato-lineatum, margine integro, dorso pilis longis aureo-fulvis quasi velutinis dense vestitum; alae albae (ex *Kerr*), carina manifeste breviores, dimidiate oblongo-cuneatae, obscure falcatae, supra unguem gibbosae; carina alba (ex *Kerr*), circiter 18 mm. longa, obtuse rostrata, inferiore margine oblique rotundato, supra medianam longitudinem 6.5 mm. lata. *Stylus* vix geniculatus, alte arcuatus, pilis ascendentibus subaureis aequae munitus. *Legumen* (vix maturum) 9 cm. longum, vix 6 mm. latum, inconspicue falcatum, sub apicem margine anteriore in rostrum vix 3 mm. longum curvatim abeunte, pilis mollibus longis subadpressis satis sordide fulvescentibus dense vestitum.

Sriracha, Nawng Kaw, on clearing in evergreen jungle, 30 m., *Kerr*, 2053.

The specimens received are all of one year's growth, but with regard to the conditions of its occurrence it would hardly be justifiable to regard the species as strictly monocarpic.

Desmodium cephalotoides, *Craib* [Leguminosae - Hedysarcae]; *D. Cephaloti*, Wall., facie similis sed floribus magnis facile distinguendum.

Suffruticulus circiter 6 dm. altus (ex *Kerr*); caules trigoni, faciebus sericei, angulis barbati. *Folia* trifoliolata, petiolo 1.5–2.5 cm. longo trigono indumento ut caulibus suffulta; stipulae

deciduae, lineari-lanceolatae, acutae, circiter 1 cm. longae, costatae sicco brunneae, dorso costa pilosae vel fere glabrae, ciliatae; foliola lanceolata, apice acuta, basi cuneata vel subrotundata, lateralialia 3·5–8 cm. longa, 1·5–2·6 cm. lata, terminale a lateralibus 1–2 cm. distans, 5–11 cm. longum, 1·5–4 cm. latum, chartacea, supra costa pilosula excepta glabra, subtus sericea, nervis lateralibus utrinque ad 10 supra conspicuis subtus prominentibus, nervis transversis tenuibus supra subconspicuis; stipellae ad 8 mm. longae. *Inflorescentia* axillaris, capituliformis; bractae vix 3 mm. longae, 1·5 mm. latae, bracteolis similes; pedicelli 4 mm. longi, sericei; bracteolae 2, oblongae, acutiusculae, 4 mm. longae, 1·75 mm. latae, costatae, dorso medio apicemque versus barbatae, ciliatae. *Calycis* tubus 2·5 mm. longus, extra parcissime appresse pubescens, intra glaber, lobi 2·5–4·5 mm. longi, ad 2 mm. lati, acuti, extra subsericei, intra pilosuli. *Corolla* alba (ex *Kerr*), glabra, 1·3 cm. longa. *Ovarium* vix 3 mm. altum, suturis pubescens.

Meh Ping Rapids, Ban Kaw, in mixed jungle, *Kerr*, 2022.

Uraria rotundata, *Craib* [Leguminosae-Hedysareae]; ab *U. lago-poides*, DC., cui valde affinis, foliorum nervis pagina utraque conspicuis, bracteis longioribus angustioribus haud vel vix acuminatis, leguminibus pallidis recedit.

Caules basi lignosi, repentes, graciles, primo breviter pubescentes praetereaque pilis paucis patentibus longis albis instructi, mox puberuli. *Folia* simplicia, ambitu plus minusve rotundata, mucronata, basi leviter cordata, 1·1–3·4 cm. longa, 1·1–2·8 cm. lata, rigide chartacea, supra pilis paucis brevibus scabridula, subtus nervis puberula et pilis paucis longioribus deciduis instructa, ciliata, nervis lateralibus utrinque circiter 7 cum nervis transversis supra prominulis subtus prominentibus; petioli graciles 1·3–2·7 cm. longi, puberuli; stipulae angustae, acutae, circiter 7 mm. longae; stipellae 2 mm. longae. *Racemi* cylindrici, ad 5 cm. longi et circiter 1·5 cm. diametro; bractae late lanceolatae, apice attenuatae, acutae, circiter 1 cm. longae et 3 mm. latae, ciliatae, extra puberulae praetereaque pilis paucis longis rigidis instructae, intra glabrae, costatae; flores gemini, pedicellis 4 mm. longis pilis longis divaricatis paucisque brevioribus instructis suffulti. *Calycis* segmenta ad 6 mm. longa, corollam purpuream superantia, pilis rigidis divaricatis tecta. *Legumen* pallidum, puberulum.

Sriracha, creeping on rocky ground by the sea, *Kerr*, 2136.

Cassia Garrettiana, *Craib* [Leguminosae-Cassieae]; *C. racemosae*, Mill. sensu stricto affinis, sed foliolis ovato-lanceolatis vel anguste ovatis acuminatis acutis, racemis brevius pedunculatis in axillis plerumque geminis, floribus majoribus recedit.

Frutex vel *arbuscula* (ex *Kerr*), ramulis puberulis cortice rubro-brunneo striato obtectis. *Folia* abrupte pinnata, circiter 15 cm. longa, petiolo communi 3·5–5 cm. longo suffulta, petiolo ima basi puberulo et ut rhachi supra canaliculato; foliola utrinque 7, ovato-lanceolata vel anguste ovata, apice acuminata, acuta, basi rotundata vel late cuneata, 3·5–8 cm. longa, 2–3·6 cm. lata, rigide chartacea, utrinque glabra, margine cartilagineo, nervis lateralibus utrinque saltem 10 intra marginem arcuatis supra conspicuis vel prominulis subtus subconspicuis vel fere prominulis, nervis transversis uti

reticulatione gracili subtus conspicuis; petioli 2-4 mm. longi, supra canaliculati, glabri vel fere glabri. *Racemi* axillares, gemini, ad 10 cm. longi, in paniculas terminales dispositi; pedunculus communis plerumque vix 1.5 cm. longus; rhachis valde nodus, ut pedunculo densius molliter puberulus; pedicelli sub anthesin 2.5-3 cm. longi, puberuli, infructescentes ad 3.5 cm. longi, paullo incrassati; bractee parvae, deciduae. *Sepala* rotundata vel late elliptica, 0.7-1 cm. longa, 0.5-0.7 cm. lata. *Petala* sulphurea (ex *Kerr*), obovata vel obovato-elliptica, 1 cm. longa, 8 mm. lata, breviter unguiculata. *Stamina* fertilia 7. *Ovarium* subsessile, fere glabrum. *Legumen* compressum, 15 cm. longitudine vix attingens, 3.6 cm. latum, apiculatum, in stipitem 5 mm. longum attenuatum, valvis brunneis tenuiter reticulatis; semina transversa.—*C. racemosa*, Benth., Trans. Linn. Soc. vol. xxvii. p. 549, quoad plantam Schomburgkianam, vix Mill.

Sriracha in scrub jungle near sea level, *Kerr*, 2067; Battambang, Anh, *Schomburgh*, 251.

Siamese name, Mè San (ex *Kerr*).

A specimen collected by Luang Vanpruk (No. 179) at Phre, 120 m., probably also belongs here though the leaflets are much larger.

Parinarium albidum, *Craib* [Rosaceae - Chrysobalanaceae]; a *P. sumatrano*, Benth., foliis subtus albo-arachnoideis recedit.

Arbor mediocris (ex *Kerr*); ramuli primo subferrugineo-tomentosi, mox glabri vel fere glabri, cortice rubro-brunneo lenticellato obtecti. *Folia* plerumque oblonga, apice truncata vel retusa, interdum breviter obtuse acuminata, basi parum inaequalia, truncata vel late cuneata, 5-14 cm. longa, 2.5-8.5 cm. lata, subcoriacea, supra costa subferrugineo-tomentella excepta glabra, subtus albo-arachnoidea, nervis lateralibus utrinque 12-15 obliquis supra conspicuis subtus prominentibus, nervis transversis supra conspicuis subtus prominulis; petioli 1 cm. longitudine vix attingentes, supra subferrugineo-tomentelli, canaliculati, subtus sericei, convexi; stipulae caducae. *Flores* in paniculas terminales ad 12 cm. longas 11.5 cm. latas dispositi; pedicelli perbreves; bractee ovatae, acuminatae, acutae concavae, deciduae, 3 mm. longae, 2 mm. latae, dorso appresse pubescentes. *Calyx* extra subferrugineo-tomentellus, intra villosus; tubus 2 mm. longus; lobi oblongi vel deltoidei, acuti, 1.75 mm. longi, 1-1.5 mm. lati. *Petala* 1.5 mm. longa, vix 1 mm. lata, ciliolata. *Stamina* 7, filamentis ad 1.5 mm. longis glabris. *Ovarium* 1.5 mm. altum, villosum, ovulis solitariis erectis; stylus 2.5 mm. longus, inferne villosus.

Chiengmai, in mixed jungle on lower slopes of Doi Sootep, 300 m., *Kerr*, 604; Kanburi, *Teysmann*.

Terminalia tripteroides, *Craib* [Combretaceae-Combreteae]; a *T. triptera*, Stapf, fructu multo majore facile distinguenda.

Frutex vel *arbuscula* (ex *Kerr*); ramuli juventute fusi, puberuli, mox glabri, cortice rubro-brunneo lenticellato obtecti. *Folia* plerumque elliptica vel late elliptica, apice acuminata, acutiuscula, basi plerumque late cuneata, 5-10 cm. longa, 3.3-5.8 cm. lata, rigide chartacea vel fere subcoriacea, supra nisi costa pilosula glabra, subtus costa nervisque primariis parce pilosula, mox glabra, nervis lateralibus utrinque 6-7 supra conspicuis subtus prominentibus,

nervis transversis subtus prominulis; petioli circiter 8 mm. longi, supra parum canaliculati, pilosuli. *Spicae* graciles, in paniculas dispositae, rhachi ramulisque subferrugineo-pilosis. *Receptaculum* 1 mm. altum, glabrum. *Calyx* pallide viridis (ex *Kerr*), circiter 1.25 mm. altus, fere ad medium lobatus, lobis deltoideis obtusis pauperrime ciliatis, extra glaber, intra pubescens. *Stamina* exserta. *Stylus* 3 mm. longus. *Fructus* 2.8 cm. altus, 3-alatus, alis circiter 8 mm. latis, glaber.

Meh Ping, Doi Noi, 300 m., in deciduous jungle, *Kerr*, 2010; Muang Hawt, 240 m., in deciduous jungle, *Kerr*, 2010a.

2010 is described as a scrambling shrub and 2010a as a tree.

Terminalia obliqua, *Craib* [Combretaceae-Combretaceae]; *T. tripteroidi*, *Craib*, facie similis, foliis longius petiolatis et acuminatis distinguenda.

Arbor (ex *Kerr*), ramulis primo breviter appresse pubescentibus mox glabris cortice rubro-brunneo vel cinereo-brunneo reticulato-striato obtectis. *Folia* plerumque ovato-lanceolata, apice acuminata, acuta vel obtusiuscula, basi inaequalia, cuneata, late cuneata vel fere rotundata, 7-11.5 cm. longa, 2.6-5.5 cm. lata, subcoriacea, utrinque glabra, nervis lateralibus utrinque 7-9 satis obliquis supra conspicuis subtus prominulis, nervis transversis uti reticulatione gracili subtus conspicuis; petioli ad 1.7 cm. longi, supra planiusculi vel parum canaliculati, subtus convexi, fusi. *Spicae* in paniculas dispositae. *Fructus* oblongus, 3 cm. altus, 3-alatus, alis vix 1 cm. latis.

Sriracha, Nawng Kaw, 30 m., *Kerr*, 2073.

Siamese name, Küm Chai (Kam Chai)—*Kerr*.

Eugenia siamensis, *Craib* [Myrtaceae-Myrteae]; ab *E. Jambos*, Linn., foliis formae diversae tenuioribus nervis paucioribus recedit.

Suffrutex vel arbuscula (ex *Kerr*), omnino glaber; ramuli graciles, cortice pallide brunneo vel rubro-brunneo obtecti. *Folia* anguste oblonga vel oblanceolata, apice acuminata, acutiuscula, basi cuneata, 8.5-13 cm. longa, 2.2-4 cm. lata, chartacea, nervis lateralibus utrinque circiter 8 rectis vel subrectis intra marginem arcuatis supra subconspicuis subtus prominentibus, nervulis subtus conspicuis; petioli circiter 8 mm. longi et 1.5 mm. crassi, supra canaliculati. *Inflorescentia* e cyma terminali 3-flora constituta; pedicelli (infra articulationem) 3-5 mm. longi. *Receptaculum* circiter 1.2 cm. altum, parte basali pedicellum simulante 6-7 mm. alta 2-4 mm. diametro parte suprema apice 1.3 cm. diametro. *Sepala* 4, basi breviter connata, subrotundata, 7 mm. longa, circiter 1 cm. lata. *Petala* libera, ad 1.8 cm. longa. *Stamina* perplurima, 3 cm. longa. *Stylus* fere 5.5 cm. longus. *Fructus* plus minusve globosus, paulo ultra 2 cm. altus, calyce styloque diu persistentibus.

Sriracha, Nawng Kai Ploi, in evergreen jungle, 90 m., *Kerr*, 2118.

Siamese name, Bang Kwan (ex *Kerr*).

Begonia (Casparya) *Acetosella*, *Craib* [Begoniaceae]; a *B. Roxburghii*, DC., foliis angustioribus basi oblique truncatis vel cordato-truncatis nunquam alte cordatis recedit.

Herba circiter bimetralis (ex *Kerr*); caules glabri vel juventute subglabri, primo flexuosi, striati, basi ad 8 mm. diametro. *Folia* alterna, lanceolata vel oblongo-lanceolata, apice acuminata, acuta,

basi oblique truncata vel cordato-truncata, 13–27 cm. longa, 3–8.5 cm. lata, membranacea, supra parcissime setulosa, subtus costa nervisque setulosa, margine setoso-serrulata, e basi circiter 5-nervata, nervis secundariis (e costa ortis) atrinque ad 7 pagina utraque sicco prominulis, nervis transversis satis distantibus utrinque conspicuis; petioli 1–12 cm. longi, glabrescentes; stipulae brunneae, lanceolatae, acutae, 1–1.3 cm. longae, 3.5 mm. latae, deciduae. *Flos* ♂ pedicello ad 1.4 cm. longo ut pedicello ♀ bibracteato suffultus. *Sepala* 2, obovato-elliptica, 1.4 cm. longa, 1.2 cm. lata. *Petala* 2, oblongo-oblancheolata, circiter 1.3 cm. longa et 0.5 cm. lata. *Stamina* perplurima, filamentis liberis, connectivo manifeste producto. *Flores* ♀ axillares, solitarii, pedicellis 0.5–1 cm. longis bracteolis majusculis stipulis conformibus paullo supra basin instructis suffulti. *Sepala* petalaeque maris sed minora.—*B.* sp. n., Craib, Kew Bull. 1911, p. 58.

Chiengmai, in damp shady spots by stream on Doi Sootep, 660–900 m., *Kerr*, 557, 1744.

Sphenodesme (*Eusphenodesme*) *mollis*, *Craib* [Verbenaceae-Symphoremeae]; ob folia subtus parce molliter pubescentia distincta.

Suffrutex scandens; ramuli primo tomentelli, mox parce pilosuli; rami glabri, cortice brunneo-cinereo parce lenticellato obtecti. *Folia* oblongo-elliptica, apice acuminata, acuta, basi late cuneata, 4–12 cm. longa, 2–8.5 cm. lata, chartacea, supra pilosula, subtus parce molliter pubescentia sed costa brevius appresse pubescentia, nervis lateralibus utrinque 5–6 supra leviter impressis subtus prominentibus, nervis transversis supra subimpressis subtus prominulis; petioli circiter 1 cm. longi, tomentelli. *Cymae* capitatae, 7-florae, in paniculas terminales dispositae; bracteae cuiusque capituli 6, oblanceolatae vel oblanceolato-spatulatae, apiculatae, circiter 2 cm. longae et 6 mm. latae, utrinque pilosulae, plus minusve distincte nervatae. *Calyx* extra subsericeus, intra superne pilosulus; tubus 3.5 mm. longus; lobi deltoidei vel late deltoidei, 1.25 mm. longi, apice breviter bifidi. *Corollae* tubus 4.75 mm. longus, lobi oblongi, apice rotundati, circiter 3 mm. longi et 2.25 mm. lati, intra basi dense villosi. *Stamina* paullo exserta. *Ovarium* pilis albidis erectis rigidiusculis obtectum, circiter 1 mm. altum; stylus circiter 6.5 mm. longus, apice bifidus, glaber.

Sriracha, Nawng Kaw, in evergreen jungle, 30 m., *Kerr*, 2075.

Hymenopyramis siamensis, *Craib* [Verbenaceae-Caryopterideae]; ab *H. brachiata*, Wall., indumento diverso, calyce fructescente multo majore recedit.

Suffrutex petiolis arcuato-deflexis scandens; ramuli subferrugineo-tomentelli; rami latere altero brunnei, puberuli, altero subferrugineo-tomentelli, striati, lenticellis (?) in lineas 8 regulariter dispositis instructi. *Folia* plus minusve elliptica, apice acuminata, acuta, basi late cuneata, ad 14 cm. longa et 7.5 cm. lata, supra parce brunneo-pilosula, subtus molliter pubescentia, glandulosa praeteraque huc illuc pilis rigidis erectis nigris instructa, chartacea, nervis lateralibus utrinque 6–8 supra leviter impressis subtus prominentibus, nervis transversis supra leviter impressis subtus prominulis; petioli ad

2.4 cm. longi, subferrugineo-tomentelli practereaque pilis paucis atris instructi. *Inflorescentia* generis. *Calyx* infructescens pedicello ad fere 2 cm. longo suffultus, ad 5.2 cm. longus, basi poculiformis, utrinque pubescens. *Fructus* dense ablo-hirsutus.

Sriracha, Nawng Kaw, in evergreen jungle; 30 m., *Kerr*, 2087.

Siamese name, Wang Sum (ex *Kerr*).

XVI.—MISCELLANEOUS NOTES.

MR. JOHN LAMBOURNE, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Assistant Superintendent of Government Plantations in the Federated Malay States.

G. MAW.—Mr. George Maw, who was born in 1832, was a man of very wide interests and for more than half a century a prolific contributor to various scientific journals. He was the head of a firm of manufacturers of artistic tiles and other kinds of pottery at Broseley in Shropshire. At first he turned his attention to British Botany, and in 1853 contributed to the "Phytologist," a paper on the plants of the Valleys of the Taw, the Tamar and the Torridge. He found *Lilium pyrenaicum* in a naturalised condition near Molton in S. Devon. In 1860 he became a Fellow of the Linnean Society, and also joined the Geological Society and the Society of Antiquaries. Maw formed a large collection of living hardy plants in his garden at Benthall Hall, Broseley, and travelled extensively amongst the mountains of Europe, Asia Minor and North Africa collecting. Among his discoveries were *Draba Mawii* on the Spanish Sierra Nevada and *Saxifraga Maireana* on the mountains above Tetuan. In 1871 Sir Joseph Hooker, Mr. John Ball and Mr. George Maw went on an expedition together to investigate the flora of the Greater Atlas, the outcome of which was the well-known book of travels published by Macmillan in 1878, to which Maw contributed an account of the geology of the country, and also Mr. Ball's "*Specilegium Florae Marocanae*," contained in Volume xvi of the Journal of the Linnean Society, in which a large number of new species are described and many of them figured. About 1875 Mr. Maw began to concentrate his attention on the genus *Crocus* and travelled extensively in Greece and Asia Minor, the head-quarters of these delightful plants, to study and collect the species in their native localities. After many preliminary studies, published in the "Gardeners' Chronicle" from 1877-81, and in the Journal of the Linnean Society, he published his great monograph on the genus *Crocus* in 1886 with quarto plates of all the 67 species drawn and coloured by himself. He presented to the Royal Botanic Gardens an almost complete set of the living plants of the different species, and so keen was his interest that he came to Kew and planted them with his own hands to ensure the species being correctly separated. Sir Joseph Hooker dedicated to him a

volume of the Botanical Magazine (30th vol. of the 3rd series), and Mr. Wm. Robinson a volume of "The Garden" with a notice and a portrait. In May, 1886, Mr. Maw left his old residence at Broseley for Kenley in Surrey, where he has lived in retirement and where he died on February 7th, 1912, at the age of 79.

J. G. B.

Pond-weed and Copper Sulphate.—A frequent application for advice made to Kew is from correspondents whose ponds or lakes are infested during summer by the various forms of *Algae* or "weed" found in British waters. Everyone knows the unpleasant nature of the scum-like and other growths that are nearly always seen at that season on still, or nearly still, water. They not only frequently destroy the beauty of ponds entirely for a time, but are offensive to the nostrils as well. A good deal of this annoyance may be avoided by the use of copper sulphate. Owing to the water of the Lake at Kew being pumped for garden purposes (including the watering of ferns and other low types of vegetation) it is considered inadvisable to use copper sulphate there, but it is employed with advantage in the smaller ponds. The proportion used is 1 part copper sulphate to anywhere from 750,000 to 1,000,000 parts of water. It is first necessary to ascertain, approximately at least, the cubic contents of the water to be treated. The sulphate of copper should be obtained in a pulverised state, placed in a porous bag, and dragged through the water until dissolved. It does not matter how the sulphate is distributed so long as it is done thoroughly. It may be dissolved previously and sprayed evenly over the surface, provided no water-lilies or other aquatic phanerogams are in growth. It may be mentioned that a cubic foot of water weighs about $62\frac{1}{4}$ lbs.

During the last two summers a striking example of the effective use of copper sulphate has been provided in St. James's Park. Previously, it had been a costly and troublesome matter to keep the water there presentable in hot weather by employing men in boats to remove the weed with rakes, &c. The copper sulphate treatment was adopted, with the result, we learn, that at a much less expenditure in money and labour it can now be kept practically free from weed.

A fact of considerable interest has also been reported by the Superintendent. The ponds are cleaned out triennially and the surplus fish disposed of. In recent years it has been found that many of the fish were badly attacked by fungus, so much so that it became doubtful whether it was advisable to transfer them to other waters. We learn that at the last cleaning out the fish were quite free from fungoid disease and remarkably clean and silvery. This is of especial interest because one of the doubtful matters about the use of copper sulphate in water was its effect on fish. It has been found in America that certain delicate species were affected, but usually when a considerably stronger application was used than that mentioned above.

W. J. B.

Horse Poisoning by *Equisetum arvense*.—Several cases of horse poisoning in which *Equisetum arvense*, L. (the common horsetail), was the suspected plant having been submitted to Kew during the last year, it has been thought advisable to take note of some experiments carried out at Valley, Nebraska, the results of which were published in the "Nineteenth Annual Report of the Agricultural Experiment Station, Nebraska" (1906), pp. 111–115.

Two animals were experimented upon, one an aged mare and the other a six year old gelding. The experiments were apparently continued longer with the horse than with the mare. No grain was given and the amount of dried *Equisetum* mixed with the hay was gradually increased from half a pound to six pounds per day. At first the animals seemed to prefer the *Equisetum* to the rest of the hay, but on the fourth day the mare and on the twelfth the horse showed an aversion to it which increased as the experiment continued till near the end the greatest difficulty was experienced in getting the animals to touch it. The first symptoms of poisoning appeared early. On about the fourteenth day the animals began to show a hesitating, staggering gait, which alternately appeared and disappeared throughout the course of the experiment. Other symptoms noted were loss of muscular control, poor condition of the flesh, and an unusual sensitiveness of the shoulder, these being accompanied by normal or subnormal temperature and a good appetite. The diuretic properties of the plant were shown by the constant saturation of the ground with urine which was persistently alkaline. It was found that in general the attacks of staggering coincided with the wet cold days, at least during the first half of the experiment. Towards the last the horse, losing control of its legs, fell many times. It also appeared more stupid and yawned frequently. The experiment was abandoned here owing to the refusal of the horse to take *Equisetum* either as hay or as a decoction. The vicious nature of the animal prevented the use of the decoction as a drench.

The conclusions arrived at are two, namely, that the weed must be present in large quantities to be dangerous to horses, but that when taken in sufficient amount it is fatal to these animals.

W. B. T.

***Symplocos luzoniensis*.**—Some confusion has arisen between two Philippine species of *Symplocos* which it is desirable to clear up. The name *Symplocos montana*, Vidal, proving untenable, because of the earlier *S. montana*, Brongn. & Gris., a New Caledonian species, the Philippine plant was re-named *S. luzoniensis*, Rolfe. To the latter Brand has now referred a specimen collected in the Caraballo Mountains, in the Province of Nueva Ecija, Vidal, 2141, which unfortunately does not agree with the original—a plant apparently not seen by Brand. From this specimen the technical description and the characters in the key in Brand's Monograph were evidently drawn. Apparently relying upon these characters Merrill has described a new species under the name of *S. depauperata*, which I cannot distinguish from *S. luzoniensis*, Rolfe. The following is the

synonymy of the two species, and as the second is without a specific name that of *S. Vidalii* is proposed :—

S. luzoniensis, Rolfe in Brit. Journ. of Bot. 1886, p. 348. *S. montana*, Vidal Revis. Pl. Vasc. Filip, p. 179 (nec Brongn. et Gris.). *S. depauperata*, Merrill in Philipp. Gov. Lab. Bur. Bull. xxix. p. 45.

ISLAND OF LUZON. Prov. Tayabas, Dolores, *Vidal*, 64 bis, 982; Mount Banahao, 1830 m., *Vidal*, 67; Prov. Benguet, Tonglon, *Loher*, 410; Atoc, *Loher*, 412; Benguet, *Loher*, 414; Data, *Loher*, 441, *Merrill*, 4526; Baguio, *Elmer*, 5909, 6508, *Merrill*, 4333, *Williams*, 961.

S. Vidalii, Rolfe. *S. luzoniensis*, Brand in Engl. Pflanzenr. Symplocac. p. 61 (nec Rolfe).

ISLAND OF LUZON. Prov. Nueva Vizcaya, Mt. Caraballo sur, *Vidal*, 2141.

The former species is readily distinguished by its smaller, more ovate, serrate leaves, and nearly glabrous calyx tube.

As *S. Brandiana*, Schlechter, in Engl. Jahrb. xxxix. p. 227, is untenable, on account of the earlier *S. Brandiana*, King & Gamble, this New Caledonian species may be called *S. oubatchensis*, Rolfe, from the mountain on which it was collected.

R. A. R.

Botanical Magazine for March.—The plants figured are *Brunfelsia undulata*, Swartz (t. 8422); *Syringa Julianae*, C. K. Schneider (t. 8423); *Dombeya calantha*, K. Schum. (t. 8424); *Corokia Cotoneaster*, Raoul (t. 8425); *Cereus Silvestrii*, Speg. (t. 8426).

Brunfelsia undulata is a West Indian species and was first introduced into this country from Jamaica about a century ago. It has white or sometimes yellowish flowers, with a very long corolla-tube, and like *B. americana*, Swartz, which differs in having obtuse instead of tapering leaves, it has a cup-shaped calyx with very short obtuse lobes. The plant which furnished the material for the figure was obtained from Messrs. J. Veitch & Sons in 1904.

Syringa Julianae was recently described for the first time from a plant supplied by Messrs. Veitch from their Coombe Wood nursery, where it had been raised from seed collected in Western China by Mr. E. H. Wilson, and grown under the name of *S. villosa*. It is most closely allied to *S. pubescens*, Turcz., and with that species forms a small group distinguished as the *Pubescentes*, which is included in the section to which the well-known *S. vulgaris*, Linn., belongs. In *S. Julianae* the younger branches, leaves and inflorescence are more or less pubescent, and the flowers are white and lilac-purple.

The *Dombeya*, as grown in the Mexican House at Kew, is a shrub 11–12 ft. high, with large 3-lobed or sometimes 5-lobed leaves. Its flowers are borne in large corymb-like cymes, and superficially resemble those of the Musk Mallow. It is a native of British Central Africa whence the first material was sent to Kew by the late Mr. Alexander Whyte, having been collected by him and Mr. J. M. McClounie. The plant from which the specimen

figured was obtained was raised at Kew from seeds received from Mr. J. Medley Wood, Director of the Botanic Gardens at Durban.

Corokia Cotoneaster is a familiar New Zealand shrub, and is recorded as being in cultivation at Kew in 1876. It thrives out-of-doors on a south wall, but is killed or injured by severe frost in the open ground. In Canon Ellacombe's garden at Bitton, near Bristol, there is a fine specimen growing in a sheltered corner, and from this the figure has been prepared.

Cereus Silvestrii comes from the Argentine Republic. It is an elegant species, having slender prostrate or ascending stems, and bright orange-scarlet flowers which are freely produced. The specimen figured was obtained from a plant purchased early last year from Messrs. Haage & Schmidt of Erfurt.

Abor Expedition.—In a letter to the Director written from Kobo on 8th December, 1911, during the course of the Abor Expedition under Major-General Bower, Mr. I. H. Burkill speaks of the climate experienced as cold at nights with the Mishmi Hills which are in sight already carrying a lot of snow. Looking eastwards from Kobo, Daphabum seems to end the mountains, but away behind, towards China, are more snows. Looking south-east no hills can be seen, so complete does the break appear between Daphabum and the Naga Hills. Snow can hardly be seen to the north in the Abor Hills; they rise like a wall hiding what lies behind the Dihong. Janakmukh is two marches away round the angle of the nearer line of hills and is stated to enjoy only five hours of sunshine in a day.

Botanically Mr. Burkill has found Kobo very interesting. The forest includes four layers:—

(1) Occupied by trees not very large leaved and wind-distributed, such as *Terminalia myriocarpa*, *Cedrela Toona*, *Cerbera*, or if large leaved deciduous, such as *Sterculia*;

(2) Occupied by smaller trees with large leaves and bird-distributed from fruits which often fall to the ground, as for example *Dillenia indica* and a Magnoliad;

(3) The air-space;

(4) Occupied by the ground vegetation of *Piperaceae*, *Rubiaceae*, &c., small leaved and bird-distributed.

Over all is a tangle of lianes, those which reach highest wind-distributed like the trees; the less lofty bird-distributed.

Measuring the light in the depth of this forest Mr. Burkill finds it to be $\frac{1}{200}$ to $\frac{1}{400}$ of what it is on the river bank.

Funtumia Rubber.*—It is not often that a plant within little more than a decade from its discovery is made the subject of an exhaustive monograph running over 252 pages, and covering nearly all aspects under which it presents itself to the botanist and the practical man. But such is the case with *Funtumia elastica* which, in Mr. Cuthbert Christy, has found an excellent interpreter.

* The African Rubber Industry and *Funtumia elastica* ("Kiekxia"). By Cuthbert Christy, M.B., C.M.

Although the existence of a new and important rubber tree in West Africa became known about 1883, it was not until 15 years later that its botanical status was made out, and then a few more years elapsed before it was sufficiently described to allow of its safe discrimination from very similar but valueless allies. Meanwhile, the commercial value of *Funtumia* rubber had become established, planting experiments had been taken up, and new areas of spontaneous occurrence of the tree added to the one originally known, demonstrating the existence of the species over a forest belt extending from Sierra Leone in the west to Uganda* in the east. At the same time a considerable diminution of the rubber supply from other African sources, and even of *Funtumia* rubber, made itself felt owing to reckless and wasteful working, and it became evident that the falling-off could in the end only be balanced by systematic planting. American rubber plants were, of course, thought of, but among the numerous indigenous sources *Funtumia elastica* seemed to be the only promising species. It was at this critical period that the author became acquainted with the plant, and the rather primitive methods by which the rubber was obtained. Recognising the great importance of the tree and the economic possibilities of a rational treatment, he set to work to study its structure and life-history, the conditions of its distribution and the chemical and physical nature of its latex. With the knowledge thus acquired, he also sought to improve the methods of tapping and of the coagulation of the rubber, and to lay down the principles for the conservation of the tree in its natural state and for its treatment in plantations. Finally he embodied his experiences in the book under review, a book which is a fine instance of how an eminently practical problem and at the same time one of applied botany can and ought to be dealt with. The author wrote out the book at home, but he did the work in the field during a five years' stay in East Africa and Uganda, and in repeated travels in most of the West African colonies. This, in connection with a truly scientific—that is, rational—working plan, will make the book of lasting value to an industry which will for long be one of the greatest assets of the tropical colonies. It may only be added that the book is very well written and amply illustrated by over 100 photographs, 10 full-plate drawings, a map, and a number of instructive diagrams.

O. S.

* Whilst this note was being written, news was received from Mr. E. Battiscombe, Conservator of Forests, of the discovery of *Funtumia elastica* in that portion of the Victoria Nyanza Basin which forms part of the British East Africa Protectorate. The tree is stated to occur there in considerable numbers at 5000–6000 feet.

